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AIDS TO CONTENTMENT,

A HOME FOR THE FLEET.

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In an article recently published by the Naval Institute I had the honor of laying before my colleagues of the service a few reflections looking towards the increased contentment of the enlisted man. In a general way, my studies of this subject have led to the conclusion that the most important thing to be done by officers, and the authorities as well, is to remove what Lieutenant-Commander McLean calls the "*unnecessary* restrictions" upon the freedom of action of petty officers and men.

The existence of these last named people is doubly artificial in that it is spent afloat and is surrounded by a thousand disciplinary rules which were originally framed to meet the needs of the British Navy, under the protectorate of Cromwell. The Articles of War of that epoch were the first of a long series gradually resulting in our own Articles for the Better Government of the Navy. Running parallel with these articles were rules, regulations, customs and traditions which have had quite as much effect upon the development of our routine and procedure as the articles themselves. We have but to read the story of Roderick

Random, by Smollett, or the published journals of the British Naval Officers of the eighteenth century, or, again, to recall the tales told by our predecessors in the American Navy, to realize how totally different are the conditions of to-day from those which existed even so recently as at the founding of our own service. It is not a savory topic but it seems well to refer to it in order to obtain a starting point for our discussion of a grave and far reaching subject. It is only in this apologetic way that I venture to repeat what a former Commander-in-Chief of mine once told me, namely, that his first and only act of positive insubordination was when, as a midshipman, he refused the duty of taking ashore, in the market boat, the women who had been brought off the night before for purposes upon which it is not well to dwell. As Dante said, "Tacere è piu bello" (silence is more beautiful).

At that period it is evident that the sailor was looked upon as scarcely human, a being to be worked to the limit, and to be denied substantially all privileges. Liberty on shore was habitually granted only after long periods and in places whence escape would be practically impossible. It these days we wonder how a small community like Port Mahon could support or survive the infliction of general leave, after six months' deprivation, given the crew of one of our frigates. On the other hand, it is only fair to say that the men themselves expected nothing better; it was the common sailor's common lot. Given over, for the most part, to evil habits and totally lacking in self respect, we need not wonder that they failed to command the respect of others or to secure the rights and immunities to which they were justly entitled.

This state of affairs continued in more or less force up to the time of the Civil War. Indeed, with modifications, its traces may be discerned somewhat later, or broadly speaking so long as sails were regarded as the chief motive power on board our ships. There were, however, as far back as the '60's, officers, wise beyond their fellows, who perceived that the sailor could not be treated in this generally heartless way without being brutalized or driven out of the service, but such cases were rare.

In the early '80's, I remember a very marked extension of privileges to the blue jacket and I recall with pride the fact that a regular scheme of liberty-giving was inaugurated by me while Executive Officer of the *Lancaster* by which every man on board

ship knew when he could get ashore and for how long. It was always necessary to retain a certain proportion for emergencies and part of my scheme permitted men who did not care to go ashore to exchange the privilege with others who did. In comparison with other vessels of the time I think the *Lancaster* was particularly fortunate, but I am ready to confess that liberty with her was by no means so freely granted, as it should be, according to more recent notions.

A gradual evolution would thus appear to have taken place on the part of the officer in his attitude toward liberty and other privileges accorded to sailors, and, on the other hand, in the enlisted personnel itself. The latter has changed so radically that it is difficult to believe the blue jacket of 1907 to be of the same flesh and blood as the blue jacket of 1800. We have to-day on board our ships men, no longer the scum of the earth, but coming from respectable families and accustomed to the nicer things of life. We have found it to our advantage to draw our recruits from these classes of society because in them we find excellent material physical, mental, and moral. Some black sheep manage to creep into the fold but the majority of our men are self respecting and well conducted citizens. I have always thought that we should be more successful in our recruiting if we were more exacting in our requirements and that, instead of accepting Tom, Dick, and Harry, as they come along and "pass the Doctor," we should inquire into their antecedents and only after assuring ourselves that the young men presenting themselves for enlistment bear good names in their own neighborhood and are clean in mind and body should we take them in. In other words we should insist upon the fact that it is a privilege and an honor to join the navy and that no indifferent material can pass muster. I am glad to believe that the recent administration of the recruiting service has been practically along the lines of my own predilection, with, as a result, a notably lessened percentage of desertion.

It is one thing to attract desirable youths to the navy but it is another thing to keep them once we have secured them. I have elsewhere strongly advocated a short term of enlistment on first joining for I can well understand the helplessness of a recruit who, after signing, goes on board ship and finds things entirely different from what he anticipated. With adverse or disagreeable conditions he can put up for a short time but the prospect of four

years is too much and often times he is led to commit the grave crime of desertion. We have recently returned to the old system of discharge by purchase which will enable a man to secure release from his contract without loss of citizenship. I should have preferred the other form, namely, a brief first term of enlistment, but as the discharge by purchase will effect the same object I am only too glad to applaud the timeliness of this measure.

Although much has been done for the betterment of conditions afloat something remains to be done. One of the urgent demands, in my judgment, is the arranging of duties, responsibilities, and rewards, generally and practically, so that a man may come to look upon life in the navy as a career or a profession. To effect this end we must provide also for his contentment while on shore. It is highly desirable, it would seem, to have among our older men, especially among the Chief Petty Officers, married men with their homes situated near where their ship is bound to be. The Department has shown great wisdom in definitely assigning certain ships to certain navy yards. Not only are repairs executed more expeditiously and satisfactorily than before but the effect upon the ship's company cannot fail to be highly beneficial. A man in the naval service may now marry with some slight expectation of being near his family whenever his ship comes into her home port.

Take, in illustration, the case of a man attached to a League Island ship, who may count with some degree of confidence upon being at that yard in the spring and in the fall for a period, which is naturally indefinite, but which in the long run will probably amount to thirty days during each season. Besides this there are occasions when, the Atlantic Fleet being in New York, Hampton Roads, or Boston, it will be possible for him to obtain a ten days leave. His is the most disadvantageous case. If he lived at Norfolk he would probably have more frequent opportunities of being with his family. The same is also true of New York and in a less degree of Boston.

One solution of this question presents itself which is due to a strong current of service public opinion in favor of basing the fleet upon New York for all its manoeuvers and exercises, except target practice and except the winter cruise in the West Indies. The proved value of Guantanamo as a base for the fleet while in Caribbean waters may be confidently appealed to in support of

this advocacy of a northern base to which is added the novel feature of a fleet home. There are many things in favor of this latter proposition. The time was when the wants of the individual ship were paramount. To-day it is the fleet which dominates, since even the squadron no longer commands the situation. The opinion is almost universally held that, besides other things, the fleet requires constant drilling in tactical evolutions. According to this view the ships should be handled individually to give their captains confidence in themselves and in their commands, as well as to provide a record by which they can be adjudged worthy or worthless; squadrons should be exercised together and against opposing squadrons, and finally the fleet should be manoeuvered as if in battle. It is all well enough to develop our gun-fire to the highest pitch of efficiency but, unless our fleet and squadron commanders learn how to utilize that efficiency the time and money spent in target practice will have been thrown away. There is no royal road to skill in handling the fleet or the units of the fleet, no God-given perfect power. Natural capacity, yes, but that natural capacity must be brought to its full fruition through days and weeks and months of constant training. That is the price of naval superiority. It can be had on no cheaper terms. What they did on a small scale last winter off Guantanamo they should do in still larger measure in northen waters. So our ships must inevitably knock about outside the greater part of their time that the people on board may learn their lesson. Yet this is only one of the many things which the fleet must do to secure war-preparation and general efficiency—things which cannot be done as well, if at all, by single vessels or even squadrons. Those who are familiar with such matters know how the interest in every drill, however unimportant, and even those confined to the ship herself, increases with leaps and bounds when the fleet assembles. Some of these drills require smooth water or an exercise ground on shore. To carry them out the fleet should spend the necessary time in a harbor offering the desired facilities. It is of universal knowledge that these very facilities are extremely difficult to obtain. Why not provide for them on an adequate scale? Incidentally I would suggest, as a means to keeping the fleet intact as far as possible, that a ship, requiring more than say 30 days for docking and repairs, be put out of commission for the time being, and her crew shifted to a vessel taken from the reserve; for it

may be laid down as an axiom that every day when the fleet is short of any of its units is a day more or less lost. Can there be any doubt that the happiness of our ships' companies would be enormously enhanced if the rule were adopted that the fleet, proceeding to sea ordinarily on Monday morning for those drills and exercises which we all know to be essential, should return to port every Friday afternoon for the replenishing of stores and the refreshment of the crew? And, if before arrival at the anchorage, the details mere made out of the men and officers to stay on board each ship as *actually* necessary for the care and preservation of the vessel, a free gangway being granted to the rest, what a world of difference it would make in the feeling of the average man. The coaling of the vessels might be done by divisions, for example, the divisions in turn coming in on Thursday for this purpose. All arrangements having been made in advance, the operation of filling the bunkers could begin as soon as the anchors are down, followed by cleaning ship and then going ashore with the rest of the fleet on Friday evening. In all my experience I have never found any unwillingness on the part of a crew to work hard and long, but what vexes and irritates the average sailor is to find, after the work is done that he is shut up on board ship with absolutely nothing to do.

If we could carry out some such plan as I have here sketched we should next have to determine at which of our ports the Atlantic Fleet can best spend its Saturdays and Sundays. Every consideration points to New York. It is central and it offers a sufficiently extensive anchorage, of which the necessary space could doubtless be reserved to the fleet, with easy accessibility to the sea. Moreover the city is large enough to absorb all the liberty men from all the fleets of the world without a tremor. They would encounter no difficulty in finding amusements to their taste and every conceivable method of spending their money. Boston and Philadelphia could do the same but Norfolk and Newport would be hopelessly swamped. Philadelphia is too far from the sea so that the choice lies between Boston and New York. The balance of hydrographical and social considerations indicates the latter as the proper place.

The fleet would naturally anchor below Tompkinsville and the question arises at once whether it would not be wise and expedient to establish on Staten Island a naval settlement containing a

recreation field for sports, a reading room, gymnasium, and club for the enlisted force, bed rooms for the bachelors and small cottages or apartment flats for the married men, a naval store similar to those of the army quartermaster, etc., etc.[1] Something of the kind is common in all military services so that the proposition is only strange in its extension to the naval profession. I am aware that this notion may appear to partake of the nature of Utopia but it is too frequently and favorably urged by many of our careful and thoughtful officers not to be worthy of consideration. The time is not far distant when the receiving ship at New York will be a receiving ship and nothing more, for the cob dock, now a playground and resort for men, is doomed. The Navy Yard is already deficient in wharfage. More piers and dry docks are imperatively necessary and the experts assert that these can only be secured at the sacrifice of the cob dock. The recruits who arrive at the yard must go eventually to a naval barracks somewhere in the vicinity. In casting about for a locality it is well to bear in mind the desirability of the establishment which I have ventured to suggest for the consideration of my brother officers. Indeed the necessity of evacuating the cob dock may possibly furnish the opportunity for founding the home of the Atlantic Fleet. It might, indeed, be found advisable to take a leaf out of the practice of the steamship lines, as has already been suggested by Captain Fiske, and have a repair force in readiness to go on board certain ships the moment they come in. It is in this way, by making minor overhaulings and adjustments at the end of every trip, that the great liners are enabled to hold their places in the sailings for a year at a time with but little loss of speed and efficiency. If the question be asked "Why not do this work by the ship's company?" the answer may be made also in interrogative form, "How about their liberty?" It is of the very essence of my suggestion that the week consist of five days hard work and two days of play and rest.

All depends upon the necessity, or at least the desirability, of a proposed fleet home in northern waters. To me it seems so obvious that I may have omitted certain arguments, which to

[1] Why not have at this point small quarters to be let at reasonable rates to married officers attached to the fleet, if private individuals, not perceiving their chance of legitimate gain in an avowed policy of the government, should fail to erect the necessary accommodations?

others will appear indispensable to proof, for fear of burdening this paper with trivial reflections.

Would this scheme pay? Before answering let us consider a bit. The total number of desertions for the fiscal year ending June 30, 1906, was four thousand. Assuming that each deserter cost the government $100.00 (surely a conservative estimate), these desertions cost altogether $400,000. If through such a system as is here suggested they could be reduced by only one-tenth the government would save $40,000 a year, a sum which would largely, if not completely, maintain the naval establishment herein planned. It must not be forgotten in the matter of desertion that a fairly large proportion of stragglers and deserters are mere human trash of whom we are only too glad to be rid. They are indeed either degenerate or mentally or morally deficient. So far as possible we should keep such material out of the navy or throw it out at an early opportunity by discharge. Those who are really worthy we should endeavor to retain to the end of their term of enlistment and to induce to re-enlist. Thus only can we achieve that permanence of the enlisted force which all recognize as so great a desideratum. The fleet home on Staten Island will be of immeasurable assistance to this end.

But it is no one branch of the service which will derive exclusive or even chief benefit from this establishment—the whole navy will profit in sharper and better drills, keener work, greater contentment, all of which may be expected of men who work like Turks from Monday to Friday and relax in the bosom of their families or under the shade of their favorite resorts from Friday to Monday.

Should this experiment in New York waters prove a success its duplicate would follow on the west coast, probably near San Francisco. A young man joining the navy would then know that his life is to be spent to a great extent at one of the two ports mentioned; he could make all his arrangements with that fact in view, could form friendships, make alliances, and, indeed, establish a home with all that the word implies. Entering the navy would then become the adoption of a definite calling or profession with a settled location from which absence would remove a man only, as a rule, for a short time, although the possibility of an extended exile ought not to be lost sight of as one of the incidents of a naval profession, yet an incident and not, as at present, the rule.

There are a great many adventurous spirits who would prefer the roving life of the old fashioned cruise and from among their number could be drawn volunteers for service in the Far East. The majority of men having adopted the naval life in all frankness and honesty would hope for duty on home stations and look for advancement and better positions from year to year. To the service they would naturally devote their best energies. It is this type of man that we wish to keep in the service. I had almost said that no price would be too exorbitant to secure this result.

The Navy has a large number of schools and courses, some of which could be well maintained at the proposed fleet home. There would gradually grow up, in such a community as is herein indicated, demands for new schools of various kinds, for it is to be supposed that young men coming ashore from the fleet would wish to benefit themselves by all the opportunities for self education which the conditions permitted. We would thus expect to see night schools, with various courses say in drafting, stenography, history, arithmetic, electricity, etc. We must not forget that we are dealing with an exceptionally alert body of men keenly appreciative of the advantages of education and ready to undertake all the labor, and make all the sacrifices, necessary for their intellectual betterment.

Such a gathering place would largely solve the vexed question of the uniform. It is disheartening to realize that the efforts of the authorities have failed to establish the legal right of a blue jacket to enter freely into public resorts. His garb, which should be a badge of honor, is made to cause him the loss of privileges. This should not be—but it is. What then? Accept the other horn of the dilemma and permit men to wear plain clothes on leave. There is not room on board ship for these extra suits but at the fleet home men could make their shift, if they desired, and go to the city indistinguishable from their fellows. What valid objections are there to this new departure? A point in its favor which is not always perceived and admitted is that the uniform marks the man as presumably easy prey to land sharks of all kinds. If not in uniform, Jack can pass through the crowd unnoticed and unsolicited.

I have purposely refrained from going into too great detail when it is quite possible that the general outline itself may be rejected by the service at large, but when I reflect that the future

abandonment of the cob dock and the adoption of the new school of the ship and of the fleet are as certain to come as to-morrow's sunrise, I must perforce beg for immediate study of this scheme, which seems to profit by so unusual a coincidence and to hold forth such great and manifest advantages for the enlisted men. If the best thoughts of the navy approves the idea I am confident the Department will accept it as the basis of an avowed policy by which officers and sailors may shape their lives, while serving under the flag.

THE VALUE OF SPEED IN TACTICS AND STRATEGY.

INTRODUCTORY NOTE.—These two short articles by Lieut. A. C. Dewar, R. N., a prize medalist of the Royal United Service Institution, are reprinted not only because of their intrinsic merit, but particularly because they treat of subjects in which the Navy is greatly concerned, and in which it is desired to interest the readers of the PROCEEDINGS. The interlined comments—objections and criticisms—are added merely in the way of suggestion, to induce the readers to think about and discuss the statements made and views expressed.

SPEED IN NAVAL TACTICS.

(Reprinted from the *United Service Magazine* for Sept., 1907.)

WITH COMMENTS.

Tactics may be classified as:

(*a*) Distant touch (over 20 miles).

(*b*) Visible touch (10 to 20 miles).

(*c*) Battle approach (4 to 10 miles).

(*d*) Battle tactics (under 8000 yards).

Distant and visible touch are interrelated with strategy, and in both the principal object will be to meet or avoid the enemy, both of which, and particularly the latter, are dependent on speed. Maneuvering for sun and sea gauges, which may often be important factors in a battle, will take place during battle approach.

[*Having the "sun gauge" presumably means being so placed with regard to the enemy that the sun is at your back and in his eyes, and having the "sea gauge" means being so placed as to be less inconvenienced by sea than the enemy is. A better term than "sea gauge" would be "weather gauge" or "weather vantage," thus including the wind and other elements which may be more important than the mere state of the sea.*]

Sun gauge calculations are too complicated and too lengthy for this article, but generally a speed superiority of at least 3 knots will be required to make certain of obtaining the sun gauge before nightfall.

[The following calculation seems to show this statement to be an error:

Let R be the radius of the slow ship's circle about common center, and S her speed, both expressed in knots. Let R+5 and S+a be corresponding values for the fast ship, the distance 5 knots, or 10,000 yards, being taken as just beyond effective range.

Then $$\frac{R}{R+5}=\frac{S}{S+a}$$

Whence $$R=\frac{5S}{a}$$

But the time in hours that it would take to complete the circle is $T=\frac{2\pi R}{S}$ *or, substituting the foregoing value of R,* $T=\frac{10\pi}{a}$. *Therefore the number of degrees of change of course, or the number of degrees change of compass bearing of one ship from the other, per hour, is* $\frac{360}{T}=\frac{36a}{\pi}=11.5a$ *(approximately). If now* ΔZ *is the change of azimuth of the sun per hour, the effective change of bearing of the sun glare will be* $11.5a \pm \Delta Z$, *according as the fast ships so move as to have the change of the sun's azimuth help or hinder getting the sun gauge.* ΔZ *varies within wide limits, the more rapidly as the sun is high, when sun gauge is of relatively small importance, but if we take it at 10° (per hour), and let a = 3, the author's value, we see that the change of bearing of the sun glare is 44.5° at best and 24.5° at worst. That is, the bearing of the sun glare may be changed 90° in from 2 to 4 hours.]*

Togo thought it worth while altering course to obtain the sea gauge, and there is little doubt that a sun angle of 30° (i. e., the angle between the enemy and sun) would seriously handicap firing.

[If this refers to Togo's change of course at the beginning of the Battle of the Sea of Japan, when he stood across the head of the advancing Russian columns—and it can hardly refer to anything else—then by this change Togo did not obtain the sea gauge but gave it to the Russians. The wind was fresh from the South or Southwest, and the Japanese, remaining to the North of the Russians until after the battle had been decided, were in the inferior position as far as sea and wind are concerned—also in

the matter of sun glare, if any sun shone that day, which it probably did not. Of course the author may in this place use the term "sea gauge" in a strategical sense, but, if so, it is a peculiar use and should have been explained.

It seems worth remarking that all the disadvantages of sun glare can be completely overcome by the use of darkened glasses, and that this should lead to their being supplied for use with all observing glasses and telescope sights.]

Battle tactics proper will open with the fleet on an initial battle course, with the maximum arcs of all ships bearing and with a good mean range, conditions which are fulfilled by the line of bearing of the column being at right angles to the point of attack—a proposition clearly formulated by the late Rear-Admiral May in 1897, and also by Lieut.-Commander Niblack, U. S. N., in a paper on "Gun-fire and Tactics" in 1903.

It was Rear-Admiral May's paper, published in the *R. U. S. I. Journal*, which gave birth to P. Z. exercises and relegated equal speed quadrilles to a subsidiary position.

Superiority may be that of fire arcs—increasing the fire volume, or of mean range—increasing the fire accuracy. Both, however, are closely related to the angle of approach, or the angle formed by the direction of the column and a line joining the two opposing leaders.

The initial battle course may be entered on by following the leader round in succession (as Togo did at Tsushima), or by coming up on a line of bearing and turning simultaneously into line ahead. The value of speed is least evident here, for the principal consideration is to turn on to a course which will bring all maximum arcs to bear at a good mean range. A slow fleet at 15 knots can turn simultaneously as quickly as a fast at 18 knots, and the gain of the latter when turning in succession is quite inappreciable (about 1 minute).

[*This is for a fleet of 8 ships at 400 yards distance.*]

When one fleet has turned and brought its maximum arcs to bear at an effective range (say 7000 yards), the other must follow suit and turn parallel to it, or expose itself to superior fire. This is the law of parallel courses—that fleets within gun range, endeavoring to exert their maximum powers of offence, tend to turn on to approximately parallel courses—a well-known feature of battle maneuvers. Speed, then, is useful in obtaining the sun

or sea gauge, but is not required in order to turn on to the initial battle course on equal terms. Both admirals are here supposed to be maneuvering in single-line tactics, which is the formation which gives the greatest liberty of movement to each vessel, permits of a rapid change of direction and course, and, above all, is simplest and easiest to maintain under battle conditions of smoke from funnels and bursting shells. Admiral Fournier's tactics—which are simply those of our old friend, the group, reduced to a carefully digested system—are not simple enough for battle.

The value of speed in battle tactics proper must now be considered.

Movements in battle will have two objectives.

Range movements—To alter or maintain the range.

Position movements—To gain a position of advantage.

[*These are admirable terms, expressing a great deal very concisely and yet with precision.*]

Range movements will consist either of turns in succession or together, ships turning till the maximum arcs are just obscuring. Any obscuration of maximum arcs within 6000 yards is uneconomical and therefore faulty. In parallel tactics a speed superiority of 3 knots will be required to close 1000 yards in 20 minutes with maximum arcs bearing. Anything less is not of much use, e. g., 2 knots difference gives a change of 1000 yards in 30 minutes, which is too slow to be really useful.

[*These statements open up a large field. The author evidently is considering the case of two fleets, abreast of one another, each in line ahead, on parallel courses, the faster of which wishes to reduce the range while the slower opposes the change. Under such circumstances the ships of the faster fleet turn toward the enemy, changing course simultaneously through the largest angle which will permit them to continue to use their entire broadsides, say 40°. In response, the slower ships must turn away simultaneously, changing course by the same amount. If now the original distance between the fleets was 6000 yards, and their respective speeds are 18 and 15 knots, in 5 minutes each of the faster ships will have transferred 321 yards and advanced 383 yards relative to her slower opponent, so that the range will have changed to* $\sqrt{(6000-321)^2+(383)^2}=5692$ *yards, or diminished 308 yards, while the bearing of each opponent is now only about 36° forward abeam instead of 40°. The fast ships can now turn*

about 4° further towards the slower ones, which latter must turn further away by an equal angle, and after another 5 minutes the range is reduced to 5384 yards, each fleet meanwhile maintaining its original line of bearing.

Thus we see that, by this method, the author's assumed excess of speed (3 knots) will enable the range to be reduced 1232 yards in 20 minutes, instead of 1000 yards as he states, and the question arises, what method of closing had he in mind, if not the one described. It is not apparent how mere change of course by head of column, keeping broadsides bearing, can change the range, provided the slow fleet, wishing to prevent change of range, always turns by head of column to the same extent as the fast one. Perhaps the explanation of the discrepancy is that Lieut. Dewar assumed a simultaneous change of course less than 40°, which would be necessary if the guns trained less than 40° forward abeam. Taking 30° instead of 40°, the change of range works out at 49.3 yards a minute, or 986 yards in 20 minutes, practically the figure he gives. On the other hand, the always interesting and well informed Black Joke, criticising Lieut. Dewar in an article which appeared in the October number of the United Service Magazine, says in reference to the subject under discussion, "By the book a speed superiority of 3 knots will enable the range to be altered in 20 minutes by 860 yards only." "But it has been discovered by actual experience that the practical alteration of range is less, very much less, than that which is theoretically possible." "It would not be overstating the case to say that not 1000, nor even half of that alteration of range, could be brought about in 30 minutes" (with 2 knots superiority of speed).

Without further attempt to reconcile these discrepancies, it may be remarked that the rate of change of range which can be brought about by the fast fleet depends to a very large degree upon the skill with which the individual ships are handled, and that, with the arcs of train now usually given to main battery guns, even with 3 knots superiority of speed, the time necessary to alter the range 1000 yards may well be sufficient to decide an action.]

Ability to select the range certainly permits one to exploit superior fire skill, for at shorter ranges the increased dangerous space compensates for inferior fire control.

Thus if fire skill is good, speed would enable one to exploit it;

and if poor, to neutralize the inferiority. There is, however, too great an inclination towards the idea of keeping at long ranges (7000-9000 yards) and exploiting fire control. Too long a range is distinctly uneconomical, the projectile's penetrative energy is greatly decreased, and the percentage of hits must be much less than at medium ranges. Probably under battle conditions hits would not exceed an average of 20 per cent at over 7000 yards. This means 6 hits out of 30 shots. It would be inadvisable to expend more than 30 shots at such long ranges; and it may be said that long-range firing (over 6500 yards) can never be more than a prelude to medium ranges. Three knots speed superiority will certainly give a fair ability to alter the range; but if fire skill and armament are equal, command of the range will give little or no advantage.

[*"If fire skill and armament are equal" it is clear that choice of range will affect nothing but the duration of the combat. But superior speed should be taken to imply inferior armament, whence we may deduce as its advantage nothing more, in the aspect now under consideration, than the power it gives to refuse close action.*]

With regard to *position* movements, speed is not required to obtain a position of equality. Speed permits a fleet to draw ahead, but the slower fleet can always place itself in a position of equality by turning parallel. This, however, postulates plenty of sea room, *which may not be available,* and then speed gives a decided advantage and binds the slow fleet down to particular tactics.

[*The real advantages of speed seem to be these—the fast fleet can get in any direction it pleases from the slow fleet and can make the latter take any desired line of bearing, by threatening to cap; it can avoid action altogether or can force an action; and, having engaged, it can to a very limited extent choose whether to fight at long range or to come to close quarters. It is often claimed that the fast fleet has a great advantage from having the initiative; that the slow fleet's movements are parries and only effective if perfectly executed. But if it be assumed, as it should be, that the slow fleet is the more powerful in armor and armament, then it becomes clear that very often the fast fleet will be the one on the defensive—the slow fleet, wishing to force the fighting, turns towards the fast fleet, not away from it, and it is the latter that must evade the blow.*

The proximity of land may hamper the movements of one as well as the other fleet, and for a fair comparison we must assume plenty of sea room.]

One writer has argued that if the fast fleet draws ahead, the slow fleet can always turn 16 points and so reverse the position. The fast fleet, however, would never turn 16 points in reply. It would turn into towards "slow's" rear ship (former leader), then, forming line abreast, concentrate on the rear ship and force slow to once more turn parallel.

[*Slow would be under a great disadvantage as regards gun fire while turning (for 3½ or 4 minutes), and the movement of reversing by a simultaneous turn does not seem to be a good one, but, supposing it to be made, there is still room for argument as to whether fast's proper reply is that suggested. The danger from slow's torpedoes must be considered.*]

In what may be called the *primary* movements, such as turns in succession, and together, speed will enable a fleet to assume its new formation or course a little quicker. Thus a fleet of eight ships at 18 knots will turn in succession on to a new course in 4.6 minutes, while a fleet at 15 knots would require 5.6. This is inappreciable, but combined with shortness of column will give a certain advantage, which is an argument for short columns of fast heavily gunned ships. Thus a fleet of eight ships at 18 knots is on a new course in 4.6 minutes, while a fleet of 12 ships at 15 knots will require 8.8 minutes to draw parallel. Columns being of equal length, however, 5 knots superiority would be required to make three minutes difference.

[*The times given are merely those required to cover the distance from center of leader to center of rear ship, or 2800 yards for an 8 ship fleet and 4400 yards for a 12 ship fleet. As a matter of fact, taking 8 ships at 15 knots, 5.6 minutes from the time the leader begins to turn, the rear ship should begin to turn, but the completion of the movement will take about 1 minute, 40 seconds longer if the turn is 90°, or about 1 minute for 45°. This consideration reduces the relative gain due to speed, supposing slow and fast ships to turn in equal times. But actually, the fast ships will probably be longer than the slow ones, and their length of column for an equal number of ships will be greater. The longer the ship, the greater distance between ships is necessary for safety.*

The difference between the time of turning for 12 ships at 20 knots and another 12 at 15 knots is 2.2 minutes, not 3 minutes, as the author claims, and this supposes that all ships keep station and 400 yards distance. The 20 knot ships would probably be at 500 yards, or even 600 yards, in which latter case it would take them 1.1 minutes longer than the 15 knot ships to make the turn.

In fact it seems clear that superior speed gives no advantage worth speaking of in maneuvering by head of column.]

Wheels and direct movements to alter the line of bearing depend on the difference of speed between the pivot and the wings, and not on the actual speed. In range movements 10° of fire arc has the same effect as 4 knots of speed; thus 4 knots will enable a fleet to alter the range 1000 yards in 15 minutes, keeping its maximum arcs bearing; while a superiority of 10° in fire arcs, with equal speeds, would enable a fleet to do the same in 13 minutes. Thus a fleet at 15 knots with 10° greater fire arcs would have an advantage in range movements over a fleet of 18 knots.

[*Here as before, verification of the author's figures is impossible without further explanation of what he assumes. If the maximum turn which will keep the broadside guns of the vessels of both fleets in action is 40°, and each fast ship turns so as to keep her slow opponent 40° forward abeam, the latter constantly turning away so as to keep her opponent 40° abaft abeam, the range will decrease 1640 yards in 20 minutes, or 1000 yards in 12.2 minutes (for 4 knots difference of speed). If the fleets are of equal speed, say 15 knots, and the guns of the one attempting to close train 10° further than those of the one keeping away, so that the bearings are 50° forward abeam and 40° abaft abeam respectively, then the range will be decreasing at the rate of 61 yards a minute, or 1000 yards in 16.4 minutes. So, with this data, it is not true that 10° of fire arc has the same effect as 4 knots of speed. The important point, however, is that there is a certain superiority in fire arc which, in the matter of range movements, is the exact equivalent of a given superiority in speed. And, whether the foregoing figures are correct, or the author's, in any event it is clear that a few degrees increase of train of a ship's main battery guns will balance the advantage of a considerable excess of speed, in range movements.*]

It has been shown that in "T" tactics speed gives no advantage so long as the slow fleet has sea room; in attempts to cross

the rear also, no advantage is obtained from speed, as the slow fleet can immediately reply by the same movement, which ends in counter circling. In pursuit tactics, in which fire would usually commence with fleets in line abreast, astern of one another, the fast gradually closing on the slow, speed gives a considerable advantage. Fast can reduce the distance 2000 yards in 20 minutes, and then, forming single line, bring all its maximum arcs on a flank ship of slow for 6½ minutes. This maximum arc fire would be possible for 18 minutes every hour.

[*If fast is 18 knots, slow 15 knots, and the initial distance 6000 yards, in 20 minutes it will be 4000 yards. If then the fast ships turn simultaneously 45°, which will take about a minute, they can open with their entire broadsides, and after steaming on the same line of bearing for 6.5 minutes, range from the leading fast to the flank slow ship will still be within 6000 yards. Then it would take another minute to turn into line abreast again. This may work out at 18 minutes of fire per hour, though the result is not self evident. But during this movement, fast would afford an excellent target for slow's torpedoes, and what if slow turned to starboard when fast turned to port?*]

Each disabled ship in the slow fleet would drop behind or be lost, while damaged ships in the fast fleet would drop to the rear in safety. In pursuit, a superiority of 3 knots is required to bring a fleet in sight to action within 6 hours, and a weak fleet, with a speed inferiority of 2 knots, could not, therefore, afford to go much beyond 170 miles from its base.

Thirty per cent fire superiority may be considered as equalizing 3 knots speed, which would correspond in 2 opposing fleets of 8 *Formidables* to an additional fleet broadside in one of 10 9.2 and 16 6-inch. The same advantage would be obtained by 30 per cent greater hitting skill.

[*This would seem to be a mere statement of opinion; at all events no data are given upon which to base it.*]

The Japanese victory in the Battle of Tsushima was partially due to speed, the causes of success being:

(*a*) Taking up a position with sea gauge ahead of the Russian line, due to superior tactical skill assisted by speed.

[*Not if "sea gauge" means what it ought to mean.*]

(*b*) Speed enabling the Japanese to keep ahead and carry out "T" tactics.*

[*Speed alone would never have enabled the Japanese to T the Russians; it required also the Russian ineptitude.*]

(*c*) Superior fire skill (according to *Brassey's Annual*, 4 hits to 1), which was probably the main factor of success.

According to "Nauticus," 1906, however, the Japanese never seem to have been more than 10° before the Russian beam, which would mean that success was almost entirely due to fire skill. It must be remembered also that five of the Russian battleships were designed for, and on paper possessed, equal if not superior speed.

The general conclusions may be summed up by the classification of speed superiority in three grades.

A. Under 2 knots, i. e., for a standard of 16 knots, 1⅛.

B. From 2 to 4, i. e., 1⅓ to 1¼.

C. Over 4, i. e., 1⅓ to 1½.

Grade A is a "slight" superiority and will not materially affect the action if the slower fleet is moderately well handled; but if the action lasts any time, the faster fleet will be able to dictate the course. This opportunity may be considered neutralized by a 10 per cent hitting superiority, due either to heavier armament or fire skill.

Grade B is an "appreciable" superiority; it will give the fast fleet great initiative, and will tie slow down to certain movements. Fast can dictate the course and will also possess considerable power to alter the range. It would require 20 per cent hitting superiority to counteract it.

Grade C is a "definite" superiority. Slow will have to observe fast's movements very accurately, and it will be difficult to prevent fast obtaining temporary advantages, when one considers that it draws ahead at the rate of 400 yards in 2½ minutes. Such a superiority would require 30 per cent greater skill to counteract it. Speed superiority is, however, only really useful if a fleet possesses an approximately equal armament. Superior fire skill will not only neutralize a considerable difference of speed, but will be constantly operative, while speed can only give a temporary advantage. As no possible speed superiority can place a

* The term "T" tactics is given to an attempt to draw ahead and concentrate on the head of an enemy's fleet, and in perfection consists of passing at right angles across it and so crossing its "T."

fleet at once, or maintain it permanently, in a position of advantage, an equality of armament and fire skill is required for those phases of the action when the fleets are relatively in positions of equality. Speed, then, tactically is a useful complement of, but can never be a substitute for, armament.

[*The foregoing statements as to the percentage of greater skill which would counteract various degrees of superiority in speed are of course mere dicta, but the percentages named are more than excessive in view of the author's failure to establish a definite and material advantage from even 3 knots excess speed. Finally, when the author states that speed superiority is only really useful when armaments are approximately equal, and indeed in all his concluding remarks, he seems to range himself on the side of those who have persistently, but unfortunately with little effect, contended that speed is a secondary quality in fighting ships, and is not properly to be exalted to the sacrifice of armor and armament.*]

SPEED IN BATTLESHIP STRATEGY.

(Reprinted from the *United Service Magazine* for October, 1907.)

WITH COMMENTS.

Position and numbers are factors so dominating in strategy that speed apparently sinks to a secondary place, but when wanted it is vitally necessary. There are two functions of speed which must be distinguished—one enables you to get to a particular area with a greater margin of time, the other to force or evade action. The first gives a slightly greater area of control, the other in a given area gives a greater certitude of it. In the first case, if the destination is at any distance, full speed will be impracticable on account of strain and possible breakdown. This ability to reach a distant place in a shorter time may be termed *the distantial function of speed,* the power to force action on a fleet when sighted *the combative function.* The latter is partially strategical and partly tactical: not purely strategical, *for the enemy's fleet is in sight; nor* purely tactical, *for battle is not joined,* and may without pedantry be termed *strategico-tactical.*

In the distantial or purely strategical use, two knots will give a margin of about five hours in a 600-mile run, which will ordinarily be of little importance.

[*If the two speeds are 18 and 16 knots, the fast fleet will take 33⅓ hours, and the slow fleet 37½ hours to go 600 miles, giving a margin of only 4 hours. A margin of 5 hours corresponds to speeds of 16½ and 14½ knots.*]

In the second case two knots may enable one to bring the enemy's fleet to action, or evade action, which may be of vital importance.

[*If the slow fleet becomes aware of the position of the fast fleet at a distance of 24 miles, it will take 10 hours for the latter to get within 8000 yards range, supposing the former to wish to avoid action; and more time than would be left in an average day would be required to bring about a decisive engagement, assuming that slow's offensive qualities are not immensely inferior to fast's. It would seem that any superiority in speed would give power to avoid action, supposing there is sea room and neglecting the bare possibility of daylight finding the two fleets close aboard, and in the case of narrow waters, or even the mere proximity of land, the particular circumstances alone could determine whether any excess of speed, or how great an excess, would permit an evasion.*]

This power to force or evade action is the primary function of speed, the ability to cover long distances in rather less time is one of subsidiary importance. The circumstances under which speed will usually be required are:

1. Reaching a sea outlet or powerful deflectionary position before enemy's fleet.

2. Reaching an attempted landing spot in a given time.

3. Reinforcing another fleet in a given time. These are dispersive or distantial functions of speed.

4. Forcing or evading action.

This is the combative or strategico-tactical function of speed. The distantial function of speed can, to a great extent, be supplemented or entirely replaced by position, but this is not the case with the combative. It would involve an excess of refinement to review in detail all the probable cases in which speed would be required under these particular categories, as it depends on the position of the various fleets, and on communication efficiency, but a short summary will be attempted.

1. Reaching a sea outlet before an enemy's fleet so as to ensure deflecting it or bringing it to action: e. g., to reach Gibraltar before

a fleet from Toulon, or Dover before a fleet from the Jade. It will be seen that the possibility of interception depends largely on previous positions and rapid and accurate communication. A speed difference of three knots in the first case will give a margin of 140 miles, Toulon to Gibraltar being 710 miles, or 47 hours at 15 knots.

47 hours at 15 knots = 710 miles.
47 " 16 " = 760 "
47 " 17 " = 805 "
47 " 18 " = 850 "

If D is distance enemy must go, S speed of enemy, d distance of English fleet, s its speed, c communication interval, then

$$c \text{ must be less than } \frac{D}{S} - \frac{d}{s}.$$

In fact, communication and previous position enter so largely into all distantial problems that it is impossible to dogmatize as to speed.

England is 300 miles ahead of Germany, and if positions are well selected, high speed for distantial purposes ought not to be necessary in the North Sea, if one could be sure of rapid and efficient communication—which is, however, just what one cannot be.

2. Reaching an attempted landing spot.

If first news is from " point of landing," and t be time required by enemy to disembark, then maximum distance of coastal torpedo flotilla should be $\frac{20t}{2}$ and of cruisers $\frac{18t}{2}$.

The approximate distances for a coastal system would thus be 200 miles for torpedo-boats (20 knots), and 180 miles for a cruiser force (second-class 18 knots).

[*Does this mean that to be effective the relieving force of torpedo boats or cruisers must arrive at the landing spot before more than half the enemy's force has disembarked, or does the author assume that it takes as long for the news of the landing to reach the torpedo boats or cruisers as it does for them to get there after the news is received? Neither hypothesis seems altogether unobjectionable. As regards both these points—the greatest distance for effective action at which a suitable naval force of given speed can be stationed, and the period free from attack which the enemy would need to effect his purpose—everything depends upon the character of the hostile expedition.*]

Speed of two knots would here give a margin of one hour or 20 miles in a ten-hour run.

3. Reinforcing another fleet (in action) in a given time. It would probably be necessary to reinforce within six hours, and a speed superiority of two knots would only mean 12 miles, a comparatively small distance.

This is more a matter of position than speed.

[*The author's conclusions regarding the distantial function of speed seems to have been well expressed by Lieut. B. E. Domville in his Gold Medal Prize Essay for 1906, when he said: "Strategical advantage is more likely to be gained by a skilful disposition of forces acting on interior lines, and by rapid and accurate information of the enemy's movements than by a high speed of the main fighting line."*]

4. Forcing or evading action. This is pre-eminently the function of speed. The superiority required to bring a fleet in sight to action in a reasonable time is from two to three knots.

[*As already remarked, if the distance of slow from fast is 24 miles when the former begins to run, it will take 10 hours for fast to get near enough to open fire (with 2 knots superiority, nearly 7 hours if the superiority is 3 knots), and from opening fire to close action will be a long time, if the fleets are anywhere near equal in gunfire, always, of course, supposing slow to do his best to keep away from fast.*]

The "in sight" condition brings it into the sphere of tactics, but it has been included because (1) if the enemy are not in sight information of their position and course, even if accurate, takes time to pass, and unless these factors are accurately known, high speed cannot be fully utilized; (2) if the enemy are over 24 miles distant, which is just over "in sight" distance, the possibility of forcing them to action within daylight hours is not great, and if night falls, the value of high speed is much less, on account of the uncertainty which attaches itself to the enemy's movements.

The value of speed in this sphere is very great. The power it gives of evading action permits isolated ships to traverse the sea in safety and frees all reinforcements and junctionary strategy of the *incubus* of being brought to action by a superior force.

[*Which is to say fast can always run away and "he who fights (not at all) and runs away may live to fight another day," which nobody denies.*]

It is asserted that speed is only valuable in running away, but advocates of this view forget that it will be equally efficacious in running after.

[*Running after what? If commerce, yes. But we are considering the speed of battleships.*]

The ability to run away means freedom of the sea, and so imperfect control by the stronger, slower fleet. A small fleet of faster and powerful ships could dislocate and very effectively dispute the control of an area by a much stronger but slower fleet, and as it could attack isolated vessels, would compel the latter to keep its forces concentrated. Briefly, then, speed gives freedom of the sea, and control interference, for an area cannot be said to be effectively controlled so long as a fast squadron of battleships can move about in it.

[*But the fast squadron can't keep on moving very long; it will have to go somewhere to coal; sooner or later it will be rounded up and have to surrender or fight. Captain Darrieus well says in La Guerre sur Mer: "Whether it be a little sooner or a little later, at the beginning or at the end of the war, battle is unavoidable, and the moment always comes when the two antagonistic forces find themselves face to face."*]

Admiral May's strategy of 1906 is an example of this: his fleet, which had only 1½ knot superiority, first threatened an important trade route and, when driven off it, appeared on the East Coast with ample fuel to take it back to port.* It is argued that Admiral Wilson was at his heels; but even if a fleet coaling at Portland can be described as being at another fleet's heels, the principal point is that Admiral Wilson could not bring him to action, and there is no reason why May should not have fuelled and carried out a similar movement again as repeatedly as a recurring decimal; for a fast fleet can always get to sea untouched, unless closely blockaded, and close blockade strategy with an enemy that is not absolutely somnolent is extremely risky, if not impracticable, in modern warfare.

[*It seems rather a broad assertion to say that "a fleet can*

* Admiral May's fleet suffered severely, but this was due to its formation and to lack of speed in some of his ships. The fleet was spread over some 200 miles and the two wing ships—the *Victorious* and *Royal Oak*—were cut off. Three other ships—the *Majestic, Magnificent,* and *New Zealand*—lacked staying power and had to drop out, but were not captured.

always get to sea untouched unless closely blockaded." Certainly there are conditions under which a blockade may be close enough to prevent the escape of an enemy's fleet and yet not too close for a reasonable degree of safety. Under modern conditions a blockade may be more effective at 100 miles than it would have been formerly with the blockaded port closely guarded.]

Unless you can bring the enemy to action, scouring the ocean at his heels will scour the trade off it almost as effectively as if he had it to himself, and to bring the enemy to action, at least an equality of speed is required, which, in conjunction with suitable positions, will probably attain the desired end.

The faster fleet, however, will require at least two bases within a convenient distance from one another to carry out such strategy successfully; one base would hardly be sufficient.

Speed, then, is essential in order to bring the enemy's fleet to action when sighted; this function may be termed strategico-tactical, and the speed required is 2 to 3 knots.

[*This should be qualified so as to read at least 2 or 3 knots; and it might well be added that the sacrifice of offensive and defensive qualities necessary to obtain such a superiority of speed is so great that the faster fleet, if of approximately the same total displacement as the slower, would have no occasion to wish to bring the latter to action.*]

In its purely strategical or distantial aspect, speed is attended by severe boiler rooms and fuel limitations. The mobility given by speed is only marginal; a slower fleet will cover 48, or at the most 72 miles less per diem, and the idea that speed will enable one to appear to-day here, to-morrow there, and the day after elsewhere is a false conception of its true sphere of utility.

One knot in 15 gives 6.6 miles, or 0.44 hour per 100 miles, and 66.5 miles or 4.4 hours per 1000, and so to gain 6 hours on a 600-mile run, a speed margin of 2 knots will be required.

[*A 15-knot ship would gain 6 hours on a 13-knot ship in a 600 mile run, but an 18-knot ship would only gain 4.2 hours on a 16-knot ship, and a 20-knot ship would only gain 3.3 hours on one of 18 knots.*]

It is clear, then, that a 15-knot fleet with 8 hours' start of a 17-knot on a 1000-mile run would reach its destination safely.

There is one point about speed which does not affect armament

or protection to anything like the same degree, and that is its uncertainty. It may be affected by:

(*a*) State of hull.

(*b*) State of sea.

(*c*) Station keeping necessities.

(*d*) Engineering skill and accidents.

(*b*) and (*c*) will probably be the same for both combatants, but it is quite possible for clean hulls and superior engineering skill to make a difference of ¾ knot. Full speed has definite limitations. Any attempt to go at full speed for more than 18 hours, or within 2 knots of it for more than 72 hours (i. e., about 1000 miles), is beyond the capacity of the average fleet. The *Drake* is only intended to obtain 30,000 h. p. for a period of 8 hours, and her maximum sea-going speed is not more than 21 knots (Attwood's "Warships"). In the futile pursuit after Prince Louis in 1902, 3 out of 12 pursuing battleships dropped out (Blue Book "Naval Manœuvres" and *Naval and Military Record*); in the maneuvers of 1903, 5 of the largest cruisers broke down; and in pursuit of Admiral May in 1906, 3 battleships out of 12 broke down (*Naval and Military Record*, July, 1906). There is also the disadvantage of using half of your prospective gunners in the stokeholds on these occasions (*Naval and Military Record*).

When passages or junctionary work, then, are in question outside 700 to 1000 miles, good steaming qualities, fuel state, and intermediate bases take precedence of the speed, and speed *qua* speed only asserts itself in entirety when the enemy's fleet are in sight—that is, in the sphere of strategico-tactics rather than of strategy proper. There are two dispositions interrelated with speed which must be generally condemned. One is the separation of a slow battle fleet in order to cover a wider search area. An enemy's fleet will either suddenly slip through or cut off and defeat a portion of the fleet. In the Frnch maneuvers of 1901, for example, the Blockading Fleet of Ajaccio, 3 miles apart, were caught at dawn by a fleet in battle formation 4000 yards off ("United States Reports from Abroad," 1902), and instances of a similar sort could be drawn from other maneuvers. Another disposition is the "chase" in which battleships carry out independent full speed trials after the enemy, who may be in battle formation. The great freedom from defects which characterised

the Japanese was probably due to the fact that they never attempted to strain their ships except in action. Separation of battleships characterised Admiral May's 1906 strategy, but most of his battleships could steam faster than the enemy. The value of a combination of speed and fuel superiority in the *King Edward* class could not have been more definitely demonstrated, and his safe passage of the Channel and Dover Straits without even an attempt at interference on the part of our destroyer flotillas was a bad feature of the maneuvers.

In conclusion, it may be asserted that high speed would not be wanted stragetically by an enemy almost equal in strength who was ready to accept action but not desirous of forcing it. High speed is required by an enemy inferior in strength who aims at disputing or dislocating the control of an area without being forced into action, and conversely by a power with vital sea interests requiring it to force an enemy's fleet to action if it issues from its ports.

[*That is to say the weaker needs speed in order to be able to run away from, and the stronger needs it in order to be able to catch, an enemy. For a ship to be both stronger and faster than another, she must be bigger. After she has been made stronger, then the policy of making her faster may be worth serious consideration, but to deliberately make her weaker in order that she may be faster is quite another thing, and it must not be forgotten that, if ships are of equal displacement, on the average and in the long run, the faster must be the weaker.*]

High speed is less necessary stragetically in the case of a fleet controlling an area with easily guarded outlets, but strategically the true function of speed is to force or evade action; to force action a superiority of 2 to 3 knots is required, to evade it a superiority of 1 to 2. Such a superiority is desirable, but how far it is practicable is for constructors to decide.

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U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

LIEUTENANT DEWAR'S PAPERS ON "SPEED IN NAVAL TACTICS" AND "SPEED IN BATTLESHIP STRATEGY."

By COMMANDER A. P. NIBLACK, U. S. Navy.

Lieutenant Dewar's contributions are altogether good. What they may lack in literary form they make up in substance. At best the total output on the subject of naval tactics, when boiled down to form a text-book for students, consists of a few tactical axioms and a mass of general and sweeping statements, deduced from very hazy data, by earnestly inclined officers, who cannot, through the nature of things, deal more than with theories. There is, however, a lot of *data* that can be obtained by battle practice which will go far towards insuring success in fleet actions if intelligently applied. Often those who scoff most at tactical essays, as being mere theory, profit most by the text. One need not have either much rank or much experience to think and see clearly, and the subject of the value of speed, in its relation to other qualities in ship design, is one about which there has been much loose writing and reasoning.

There are two admirable features of Lieutenant Dewar's papers, apart from his treatment of the subject of speed. The one is, he substitutes such terms as sea gauge, sun gauge, fire skill, fire arcs, fire volume, position movements, initial battle course, primary movements, angle of approach, and counter circling for expressions which usually involve a whole phrase, and he gives actual figures for range and position movements which, whether or not accurate, make one immediately start figuring to prove that he is probably all wrong.

With regard to the first feature, the concise terms are a bit confusing, and, while admirable, should be inquired into before being accepted. Sea gauge is not the old weather gauge, but it is what is sometimes called the "weather vantage." It is all

right if it is understood to be dependent upon the *weather*. There is no sea gauge with light breezes and a comparatively smooth sea, whereas the weather gauge would be there in the case of sailing ships. As to sun gauge there *is* none on many days, and, with colored glasses on telescope sights, it need not be a very important factor, except on certain days. The term position movements to express advance, and range movements to express transfer, are altogether admirable. The "angle of approach," defined as the angle formed by the direction of a column and a line joining the two opposing leaders, is very good. The "law of parallel courses" whereby fleets within gun range, endeavoring to exert their maximum powers of offense, tend to turn on to approximately "parallel courses" is well stated. Counter circling is better than "chasing tails." While we are on the subject of definitions, it is well known that the British expression "line ahead" is our column; that "line abreast" is our line; that "bow and quarter line" is our echelon; and that *line of bearing* is generally used to denote intermediate formations. As a matter of fact echelon is no longer a necessary definition, since line of bearing covers all formations other than line or column. The two important factors in relation to gun fire, or fire arcs, or naval tactics in general, are the *course* and the *line of bearing*.

As to the second point, it is not so important that the actual figures given by Lieutenant Dewar, in the range and position movements, should be exact as it is that he should offer *his* solution of the problems. No one is obliged to accept them. No one would be justified in accepting them as the actual data with fleets on the high sea until they have been worked out practically. He merely states the problems. How much more valuable a statement is such as "generally a speed superiority of at least three knots will be required to make certain of obtaining the sun gauge before night-fall" than a general statement such as "superior speed can obtain the sun gauge." One can work out for himself the real variable to suit different assumptions. With sweeping general statements one can only shrug one's shoulders. Both papers give many concrete statements bearing on range and position movements, and, whether or not accurate, are valuable.

The great defect with the game-board work afloat is that excellent outfits are furnished ships, with books of rules, but no concrete examples are given for solution. How much better it would be to hand out monthly problems for solution on each ship. Very

few officers get beyond the point of learning some of the rules, and few know how to manipulate the tools. Give problems and require results to be submitted, and it will be found that there are many side issues which will come up which will overshadow in importance the problems themselves. As gunnery is the test of ordnance, so battle tactics with ships at sea will search out the unexpected weaknesses of game-board theories. Pages of essays on naval tactics will melt into a few leading principles, and the real problems will be found to be such vital and unsolved ones as to how the captain is to really handle his ship from the conning tower, where the executive officer is to be, and what the navigator should do. "Who is the officer of the deck?" will then be not an important signal in naval tactics.

When two fleets approach to the attack, it is in order to make a number of observations and calculations. Naval tactics is a combination of calculation and judgment. Anyone who thinks he can judge with his eye fleet dispositions and movements should be removed as dangerous. Plotting relative positions is the only safe course. The word "Bunsby" may well be applied to designate the tactical disposition of two opposing fleets as some one sees it as distinguished from the plotted position which bears surprisingly little relation to the "Bunsby." The "vernier eye" is an affliction, prolific in "Bunsbys," and peculiar to people of great self-appreciation.

On the approach to the attack, the navigator should take the bearing of the head and rear of the enemy's formation. The range-finding officer gives him the distance of the enemy's head and rear ship. He then plots to scale, on special plotting sheets, the course and formation of his own fleet, and the distance and bearing of the head and rear of the enemy's formation. This gives a good idea of the line of bearing of the enemy's formation in relation to his own. To check it he counts the number of ships of the enemy and divides the plotted length of the enemy's formation by the number of ships less one. He knows that between three hundred and fifty and four hundred yards is the least distance they can be apart, so he can judge by the result how near formation of the enemy is parallel to his own or considerably converging. In other words he can check the plotted results. Repeating the plotting at intervals, he can judge the relation of the enemy's *course* to that of his own. This gives data for setting the change of range instrument, based on relative courses and

speeds. As the fleet approaches battle range all the tactical data as to range and position movement become important, and that is where Lieutenant Dewar's problems come into play.

Most battle exercises and game-board battles begin, as to records, when gun fire comes into play. On the game board you can see and judge courses and lines of bearing. *The real importance in battle or battle exercises is in the approach* and to get an advantage requires accurately plotted data. "Bunsbys" will not answer. Battle exercises are dull if they are merely duels with guns and torpedoes, long drawn out, with the solution in plain sight when gun fire opens. The really valuable experience is in the approach.

This is all, however, aside from the considerations of speed. What Lieutenant Dewar has to say may be summed up in a number of general statements.

"Strategically, this power to force or evade action is the primary function of speed." . . . . "The ability to run away means freedom of the sea, and consequently imperfect control of the sea by the stronger but slower fleet."

"Tactically," he says, "speed superiority will give the fast fleet great initiative" and "tie the slow down to certain movements" or "the faster fleet will be able to dictate the course." He also says: "Speed enables ships to turn more quickly in performing primary evolutions" (such as simultaneous or successive changes of course). So far there is nothing to challenge, but in the generalizations which here follow, there are certain reservations or qualifications needed:

"Speed permits a fleet to draw ahead, but the slower fleet can always place itself in a position of equality by turning parallel," or "with regard to position movements speed is not required to obtain a position of equality." This statement, for both amount to saying the same thing, has been made so often that a great many people believe it. As a matter of fact the slower fleet can *never* place itself in a position of *equality*. It can "save its bacon" or "make the best of it" by turning parallel. Speed permits a fleet to draw ahead, but, if the faster fleet is steering parallel to the slower, the slower manifestly cannot "turn parallel." It is true that a *position* of equality may be *apparently* taken by the slower fleet turning away from a faster fleet which is threatening to "T" it, but the convex formation is always tentatively disadvantageous for most forms of concentration of fire, and the con-

cave formation of the faster fleet is always potentially superior for concentration. The value of concentration of fire is as much of an unsolved problem as speed, but, even if the natural target is always taken by each ship, the slightly concave formation is the more favorable. If there is any advantage in large arcs of fire surely the concave formation reduces the arcs in each ship by an amount equal to the angle between the course and the tangent to the curved course. This may last only for several minutes (say during the necessary change of course) but it might interfere somewhat with gun-fire. As a matter of fact it is easy to exaggerate the fire-arc question, for most ships the world over, are pretty much equal in this respect, or at least few if any are deficient.

There are three statements of the author, which, taken collectively, do not hang together. "If fire skill is good, speed enables one to exploit it, and, if poor, to neutralize the inferiority" . . . "Three knots speed superiority will certainly give a fair ability to alter the range" . . . "Speed superiority is, however, only useful if a fleet possesses an approximately equal armament." How three knots superiority is to be obtained is not stated, but the statement is valuable because open to challenge. The last statement is not clear.

However, Lieutenant Dewar sums up by saying: "As no possible speed superiority can place a fleet at once or maintain it permanently in a position of advantage, an equality of armament and fire skill is required for those phases of the action when the fleets are relatively in positions of equality. Speed, then, tactically, is a useful complement of, but can never be a substitute for armament." Now, while I believe that speed superiority *can* place a fleet in a position of advantage, and that speed is under all circumstances a valuable and important tactical asset, the price that has to be paid for speed in increased displacement, without unduly sacrificing other qualities, is the question that has to be considered. That is about all there is to it. The question of speed is a relative one. As used in this discussion it means the extreme speed of the epoch discussed.

The author credits me personally with an essay on "Gun Fire and Tactics" in 1903, and Vice-Admiral May with ante-dating me on the tactical proposition that the best formation for the approach to the attack is line or line of bearing at right angles to the bearing of the enemy's formation. As a matter of fact, in the Prize

Essay of 1896, on "The Tactics of Ships in the Line of Battle," I advanced the proposition: "Under average conditions the best initial formation for the approach to the attack is line . . ." "When the enemy is sighted form line at right angles to his bearing . . . ." This formation is the armed reconnaissance in force preliminary to battle tactics and in no way commits the fleet to remaining in the formation, because line can at once be changed into column if desired, as soon as the measure is taken accurately of the enemy's formation." As this statement was challenged very emphatically when originally annunciated the year previous I regarded it as rather bold at the time. At present I think it needs modifying to the extent of saying "line of bearing" instead of "line." An officer in our navy who is doing more than any other to put practical tactics on a working basis said recently "As a compass is necessary when steaming ahead on any line of bearing, it seems now to be practically impossible to attempt this formation when steering from the conning tower, using a sluggish compass, and expect vessels to keep accurate position. But, as line of bearing formations are essential to the tactics of the guns, ships must learn to keep accurate positions in the formation, and to that end, I think it quite necessary that all squadrons, divisions, or sections of ships when underway between ports, should steam a certain portion of time each day on lines of bearing, steering from the conning tower" . . . "Secondary only to accurate shooting, which includes spotting, is accurate station keeping. One ship out of position can easily throw out all the others, and greatly increase the time for performing any maneuver, even to the extent of throwing the squadron out of all formation."

Anyone who writes on modern steam-fleet tactics renders an important service. Criticism is to be expected, and welcomed if it sheds new light. The proportion of practical data, in comparison to theoretical, is so small that what anyone really knows is relatively very little. The point has not yet been reached where secrecy can do more than stifle progress. The more light the better—not the light that comes from the midnight oil, but that furnished by the oil of sea-experience. I, for one, as a freshman in the school of modern steam-fleet tactics, am under many obligations to Lieutenant Dewar for all of his writings, and I hope he will give us some ideas on concentration of fire, the conning tower, and the approach to the attack, etc., alongside of which the question of speed seems somewhat academic.

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U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

THE COURT-MARTIAL OF COMMODORE DAVID PORTER.

By Lieut.-Commander Edward L. Beach, U. S. Navy.

David Porter is remembered by all Americans as the naval officer who, in command of the United States Frigate *Essex,* in the War of 1812, was overwhelmed, defeated, and captured by two British frigates in a harbor of a neutral country, Chili. But though defeated, the career of the *Essex* under his command was so helpful and gratifying to the American cause that he received unstinted praise and applause from his countrymen. Eleven years after this Commodore Porter was court-martialed on charges of disobedience of orders, insubordinate conduct, and conduct unbecoming a naval officer; was convicted, and sentenced to be suspended from duty for a term of six months. Smarting from what he considered an injustice, he resigned, and accepted service with the newly created Republic of Mexico as commander-in-chief of its navy. He remained in this position for four years; it was productive of nothing but disappointment. In 1830, a year after his return to the United States, President Andrew Jackson sent him to Constantinople as the American diplomatic representative, where he remained until his death in 1843.

Over eighty years have passed since Porter's court-martial, and the fierce animosity it caused, maintained by newspapers and magazines, is forgotten. All now remembered of David Porter is his remarkable cruise to the South Pacific, and the defeat of the *Essex* by the British ships *Phoebe* and *Cherub.*

The charges upon which he was convicted in no way affected his personal rectitude. They were based upon his actions while in command of an American squadron devoted to suppressing piracy in the West Indies. This court-martial must be of lasting interest to all naval officers, and generally to all students of inter-

national law. In spite of the great services of Commodore Porter and of his highly honorable career, and in spite of the clamor at the time against his conviction, it must be agreed that the occurrences of the last eighty years have set their approval upon the action of the government in that case, and that the verdict of the court was a just one.

Porter's character was similar in many respects to that of John Paul Jones, and Andrew Jackson. He had the bravery, the daring, the recklessness of each. When employed against his country's foes it was always to the great benefit of his own countrymen. But his was a great spirit impatient of restraint. When far beyond the reach of national control he acted as if possessed of the sovereign powers of his country. He made war and conquered a hostile population of over 16,000 in the Marquesas Islands, and formally took possession in the name of the United States. He had entered the Pacific Ocean without the order or knowledge of his own government, had captured twelve armed British ships mounting 107 guns with cargoes valued at $4,000,000, and had rid the Pacific Ocean of the British flag. This enabled numerous American whale ships to pursue their calling without fear of capture.

It is easy to understand that this lofty spirit, which neither difficulty nor danger ever intimidated, under peculiar circumstances was well qualified to bring glory to his country's flag. But also can we comprehend that it was easier for him to make precedent than to follow it, and that restive under control and impatient under affront, his zeal for the honor of his country's flag should have led him into grave error. One of his officers, while ashore in Porto Rico, was insulted by a Spanish official. On hearing this Porter landed troops on Spanish soil and demanded immediate atonement under the alternative of severe retribution.

This was like Porter, and it was like Andrew Jackson in Florida in 1817. And however wrong it was, it could not but touch and quicken American pride.

A government of course is responsible for the acts of its agents, and Porter's proper course was to report the affair and request instructions. Instead, without direction from his own government, he committed an act against a friendly government that might have led to war.

Porter's character was one of the most striking of his day. It

was as natural for him to cruise to the Pacific, to conquer and take possession of far away lands, without orders, and in the complete ignorance of his own government, as it was for him to land armed troops upon Spanish territory and demand an apology for an insult put upon an American officer. It is interesting to examine the influence that developed this character.

Porter was born in Boston, in 1780. During the Revolutionary War his father had commanded two armed ships that operated against the British. His father had been captured and for a time had been confined aboard the prison ship *Jersey*. His father's brother, Samuel Porter, had died while a prisoner aboard the *Jersey*.

The subject of this sketch went to sea at the age of sixteen. Twice during the following two years he was impressed into British war ships, each time soon making his escape. At the age of eighteen he was warranted a midshipman in the U. S. Navy, and saw his first naval service aboard the *Constellation*, under the command of Captain Truxtun. Here, as midshipman of the foretop, he was present in the action with the French frigate *Insurgente*.

He was promoted to be lieutenant a year later. Just at this time, while searching in Baltimore for deserters from the *Constellation*, he was assaulted by a drunken tavern keeper, and promptly killed the latter with his side arms. For this act he was never called to account.

He was now, in 1799, ordered to the *Experiment* as first lieutenant and served aboard her for over a year. Here his captain was Charles Stewart. During this time the *Experiment* was four times in action with French armed ships, and was invariably the victor. In each of these actions Lieutenant Porter distinguished himself by his personal valor, and also by his excellent judgment.

In 1801 David Porter was first lieutenant of the *Enterprise*. War now existed between the United States and Tripoli, and aboard this ship he was twice in action against the Barbary pirates, both times successfully.

In 1803, when the *Philadelphia* went on the rocks off the harbor of Tripoli, Porter was her first lieutenant. With the rest of the ship's company he remained a prisoner with the Tripolitans for the ensuing nineteen months. Upon his release, in June, 1805, he was given the command of the *Enterprise*, and in April, 1806, was commissioned master-commandant.

This is a bare recital of facts, not interesting perhaps, as here given. But it was a formative period for our young navy. Porter had fought under such commanders as Stewart, Truxtun, Rodgers, Preble, Dale, and Bainbridge, none as yet, except Dale, famous. The sea fights with the French and with the Barbary pirates developed the skill and the confidence of our officers, and the direct result of this was shown in the sea fights of the war of 1812.

When Porter was commissioned master-commandant he was twenty-six years old. He had been constantly at sea for ten years; he had been repeatedly in naval action during the last eight years. He had invariably distinguished himself by great personal bravery, as well as by excellent judgment when fighting, and was an officer of well-known, deserved reputation. At this time his contemporary officers regarded him as a capable seaman and navigator as well as a hard fighter.

Two years later Master-Commandant Porter was commanding the government naval forces at New Orleans. Here he was busily occupied in destroying pirates and repressing French and Spanish privateers. He was far from government control, and his orders were general in scope. They would have justified a weak man in doing nothing, and they gave great opportunity for action to a strong man. The country was in a turmoil. Pirates and privateers abounded and recked little of any law, and disdained all restraint. Porter had command of a number of gun boats, and he laid heavy hands on these lawless folk. He acted largely on his own initiative, and his course gave much satisfaction to the administration at Washington.

His reputation was now so firmly established that it is not surprising that, in 1811, when war with Great Britain was anticipated, he should have been ordered to the command of the frigate *Essex*. The *Essex* was a captain's command, a command Porter could not have expected, he being but a master-commandant at the time. That Porter, when master-commandant, should have been given this command when war was impending, bespoke a special confidence in him by the government.

On January 19, 1813, the *Essex* anchored off the island of St. Catherine, on the coast of Brazil, 200 miles south of Rio Janeiro. Porter's orders were to join Commodore Bainbridge, and St. Catherine's Island was the last of three different rendezvous

appointed for this purpose. Bainbridge was in none of these places, nor, had Porter now, any idea where Bainbridge might be. St. Catherine's Island was untenable for the *Essex*. The latter had made many prizes and British war ships were looking for her. Neither could provisions in any quantity be obtained there. Porter learned that British war ships were at Rio Janeiro, Montevideo, and Buenos Ayres, and were looking forward to meeting the *Essex*. His position was now desperate. To remain where he was was to invite certain capture. At no port on the eastern coast of South America could he obtain supplies, to attempt to enter any would bring on action against vastly superior forces. The coast of the United States now swarmed with British war ships. The *Essex* might have attempted to return there, and might have fought a successful frigate action and reached a United States port in safety. This was the best to be hoped for. But capture by a superior force was more probable. And even had the *Essex* reached a home port she would there have been blockaded for the rest of the war. So Porter reasoned. He determined to cut loose entirely from the letter of his instructions and put the *Essex* where she would do the enemy most damage. Without communicating his plan to a soul, short of provisions, needing repairs, he steered south. Until the *Essex* started to round Cape Horn none on board knew whither she was bound. This was necessary. At this time there were no British war ships on the western coast of South America, but there were many armed whalers, as much bent on making prizes of American merchantmen as of taking whales. Porter's capture of these armed whalers, making cruisers of some of them, belongs to another chapter. But to understand his character it is necessary to know what he did at Nukahiva, one of the Marquesas Islands. He arrived there for the purpose of repairing the *Essex*. Soon hostilities broke out against him, though he made great efforts to cultivate friendship with the natives. Forced to make war, he did so with a vengeance, and conquered a hostile population of over 16,000. He then took formal, official possession, in the name of the United States. In his journal of the account of his action, he says: "I believed that the possession of this island might at some future period be of importance to my country." What wonderful prescience!

The capture of the *Essex* by two British war ships, while she

was at anchor in a Chilian port, was one of the most savage sea fights in history. Aboard the *Essex* fifty-eight were killed, sixty-five wounded, and thirty-one were missing, probably drowned. After two hours of awful conflict there were not enough men left to fight the ship, and the *Essex* was surrendered. She had been overwhelmed by a vastly superior force.

On Porter's return to the United States he was greeted as a national hero. There was no limit to the adulation that was poured upon him.

In 1815 the Board of Naval Commissioners was formed. The duty of this board was, under the Secretary of the Navy, to control and have charge of everything pertaining to naval affairs. The board was composed of three naval officers, and very naturally Porter was made a member of it. He remained a member of this board for seven years, exercising great administrative powers in the government of the navy. On February 1, 1823, he was appointed to command a squadron which was to cruise in West Indian seas and the Gulf of Mexico, "for the purpose of repressing piracy and affording protection to the citizens and commerce of the United States."

In the foregoing incomplete sketch it has been the purpose to touch on those points only in Porter's career that were indicative of his character or that helped to form it. It is of course disconnected. But it is hoped that Porter's personal bravery has been made clear, and also his entire willingness to act on his own initiative, and to assume great responsibility. He was now famous and had the entire confidence of his government. As a naval officer he was magnificent in war, but in a particular emergency he proved to be a failure in peace. The reason he was a failure then, was that in peace times he was disposed to war, and was well calculated to provoke it. He was restive under his government's orders, though exacting the most explicit obedience to his own.

He failed to realize that one of the highest duties of the naval officer is under all circumstances, to avoid giving offence to a friendly power. He must needs protect his flag from insult, but if insult be given by the agents of a responsible power the naval officer must refer the affair to his own government rather than seek redress by his own summary action. Porter's whole career was against this view. He had been accustomed to act without

orders or against them, and he had uniformly been praised in consequence of the results of his so doing. In his campaign against West Indian pirates much was left to his discretion, and events proved that however magnificent his discretion was for war time it was indeed a dangerous element for times of peace.

It is not the intention here to follow Porter's campaign against the West Indian pirates. It is enough to state that when he finished with them those that were left alive were apparently a well-disposed, amiable set of men.

The occurrence that led to Porter's court-martial was known as the Foxardo affair. This story is best told by presenting to the reader the original letters in the case. The first is from Lieutenant Charles T. Platt, commanding the U. S. Schooner *Beagle*, to Commodore Porter. It is as follows:

U. S. S. BEAGLE, ST. THOMAS'S, 11 Nov'r., 1824.

SIR: At 10 in the morning of the 26th of October last, I received intelligence that the American consul's store had been forcibly entered on the preceding night, and robbed of goods to the amount of $5000. With this report the American consul requested me, provided it would prove consistent with my duties, to sail in quest of those, whom it was supposed had clandestinely left the harbor the night preceding in a small boat, and generally believed by those acquainted in St. Thomas, to have proceeded to the port of Foxardo, on the east end of Porto Rico.

I directly gave the necessary orders to prepare for sea. . . . . and at sunset came to anchor in the harbor of Foxardo.

On the morning of the 27th, a Creole visited me from shore, who bore an invitation from the commandant to me to visit him. At 7 a. m., in company with Lieut. Ritchie, the pilot, and the consul's clerk, I landed. For our better success, we appeared in the character of citizens. On my reaching the shore, the register of my vessel was demanded; I explained the object of my visit and the policy of appearing in disguise; this, however, proved of no avail; I was not allowed to proceed to Foxardo. Supposing that the person who made these demands had no authority to detain me, I, in company with Lieut. Ritchie, proceeded to the fort of Foxardo, and explained, in the most satisfactory manner to the captain of the port, the object of my visit, and produced a private letter from Mr. Cabot, American consul, to a merchant in that place, in relation to the service in which we were engaged. Having observed the necessary forms and ceremonies with regard to the captain of the port, we then waited upon the alcalde, and further acquainted him with our mission, etc., who proffered us every assistance. Having made a few inquiries in some of the retail stores which had an immediate tendency to bring to light any who may have been engaged in this traffic, we received a positive order to repair to the alcalde's house, where we were also received by the captain of the port, who damn'd us as pirates, and requesting of me register, papers, etc., I stated I possessed no register, I carried no papers, other than my commission, and

that of my officers. We were seized as culprits and conveyed to prison. To satisfy them of my real character, of which they pretended they had no positive proof, I consented, though repugnant to my feelings, to have my commission sent me; after its production, they declared it a forgery, and again remanded us to prison, declaring he would not release us until he had heard from St. John's. I then demanded to know what was further required? The reply was, "Your appointment as lieutenant-commandant of that vessel is what you must produce." I at first hesitated, and would not comply, but not wishing on my part to commit any action which might have a tendency to disturb the harmony existing between the respective governments, I produced my appointment as lieutenant-commandant. A council of officers was called with other citizens of the place, who, after having heaped upon us the most shameful outrages, permitted us to depart on board.

I have the honor, to be respectfully, your ob'dt servant

CHARLES T. PLATT,
Lieut.-Comd't. U. S. Schooner *Beagle*.

TO COMMO'E DAVID PORTER, U. S. N.

The next day Commodore Porter appeared off Foxardo with several of the vessels of his squadron, landed an armed force, and despatched the following letter to the alcalde of the town:

U. S. SHIP JOHN ADAMS, Nov. 12, 1824.

Sir: It has been officially reported to me, that an officer under my command, who visited the town of Foxardo, of which you are the chief, in search of robbers and freebooters, who with a large amount of American property, were supposed to have taken shelter there, and bringing with him sufficient testimonials as to his object and character, was, after they were all made known to you, arrested by your order by armed men, and shamefully insulted and abused in your presence by the captain of the port, after which he was sent, by your orders, to prison, and when released therefrom, was further insulted and abused by the inhabitants of the town. His object in visiting Foxardo has by these means been defeated, and for these offenses no atonement or explanation has yet been made.

The object of my visit is to obtain both, and I leave it entirely to your choice, whether to come with the captain of the port and the other offenders to me, for the purpose of satisfying me, as to the part you have all had in this shameful transaction, or to await my visit at your town. Should you decline coming to me, I shall take with me an armed force, competent to punish the aggressors, and if any resistance is made, the total destruction of Foxardo will be the certain and immediate consequence.

If atonement for the injury is promptly made, those innocent of the offences will escape all punishment—but atonement must and will be had, and if it is withheld from me, they will be involved in the general chastisement.

I shall hold the town and vessels in the harbor answerable for any detention or ill-treatment of the officers who bear this letter.

I allow you one hour to decide on the course you will pursue, at the

expiration of which time, if you do not present yourself to me, I shall march to Foxardo.

I have the honor to be, with great respect, your very obedient servant,

D. PORTER,

To the ALCALDE OF FOXARDO.

Porter's official report of the occurrence is as follows:

U. S. SHIP JOHN ADAMS, PASSAGE ISLAND, November 15, 1824.

SIR: I have the honor to inform you that, on my arrival at St. Thomas's, I was informed by Lieut.-Comd't Platt, of the United States Schooner *Beagle*, who had visited Foxardo, a town on the east coast of Porto Rico, about two miles from the sea, for the purpose of making inquiries respecting a quantity of dry goods, supposed to have been deposited there by pirates, was, after being recognized as an American official by the proper authorities, there imprisoned and shamefully treated.

Indignant at the outrages which have been so repeatedly heaped upon us by the authorities of Porto Rico, I proceeded to this place where I left the ship, and taking with me the schooners *Grampus* and *Beagle*, and the boats of the *John Adams*, with Capt. Dallas and part of his officers, seamen, and marines, proceeded to the port of Foxardo, where, finding preparations were making to fire upon us from the battery on shore, I sent a party of seamen and marines to spike the guns, which was done in a few minutes, as the Spaniards fled on the landing of the party. I then landed with two hundred men, and marched to the town, spiking on the way the guns of a small battery placed for the defence of a pass on the road, and reached the town in about thirty minutes after landing. I found them prepared for defence, as they had received intimation from St. Thomas's of my intentions of visiting the place. I halted about pistol shot from their forces drawn up on the outskirts of the town, and sent in a flag requiring the Alcalde or Governor, with the captain of the port, the principal offenders, to come to me to make atonement for the outrage, giving them one hour to deliberate. They appeared accordingly, and after begging pardon (in the presence of all the officers) of the officer who had been insulted, and expressing great penitence, I permitted them to return to the town, on their promise to respect all officers who may visit them hereafter.

We then returned to the vessels and left the harbor, after being at anchor three hours. As we were getting under weigh, a number of persons appeared on the beach, bearing a white flag, and having with them some bullocks and a number of horses, apparently laden, no doubt a present from the authorities of the place, which they informed me they should send me.

There is no doubt that our persons and our flag will be more respected hereafter, than they have been by the authorities of Porto Rico.

Every officer and man on this occasion conducted themselves in a manner to meet my entire approbation.

I have the honor to be your obedient servant,

D. PORTER,

HON. SECRETARY OF THE NAVY.

The above three letters, which are the original documents in the case, succinctly give the details of the once celebrated, now entirely forgotten, "Foxardo affair." They clearly indicate that Commodore Porter was still in character the famous "Essex Porter" of the war of 1812.

The reply of the Secretary of the Navy, Samuel L. Southard, was to relieve Porter from his command, and to order him before a court of inquiry to investigate what the Secretary called "the extraordinary transactions at Foxardo."

Porter was permitted, though not required, to be present at this inquiry. He attacked the competency of the court on the ground that two of its three members were his juniors in rank. His plea was overruled, and he left the court in high dudgeon. He wrote a number of trenchant letters to the Secretary of the Navy, and caused to be published an account of the Foxardo affair, to which he appended his correspondence with the Secretary, and the record of the proceedings of the court of inquiry.

On July 7, 1825, he was brought to trial before a naval court-martial on charges of disobedience of orders, insubordinate conduct, and conduct unbecoming a naval officer. The specifications were that he landed in the dominions of the king of Spain in a forcible and hostile manner and in military array, and did there commit acts of hostility, in contravention to the Constitution of the United States, the laws of nations, and his own particular instructions. That he had written sundry disrespectful letters to the President of the United States, and to the Secretary of the Navy. That he had caused to be published the proceedings of the court of inquiry before the latter had been transmitted, or the government had acted on them.

The court-martial met daily from July 7 until August 13. An enormous mass of evidence was presented to the court, but it all boiled down to the three letters already seen by the reader. It must be admitted by all who have waded through the voluminous record of this court that Porter at all times was impatient, contentious, and truculent. His entire defense was the orders he had received from the Secretary of the Navy. These orders are too long to be here inserted. They directed Porter to repress piracy, to afford protection to the person and property of citizens of the United States. He was authorized to pursue pirates into desolate uninhabited islands, where the active authority of govern-

ment did not extend, and to pursue them into settled islands to aid the local authorities to capture them, giving previous notice this was his whole object. When a local government existed he was to act only in aid of and co-operation with it, and the local authorities in all instances were to be respected. Porter's orders were as strong in their requirements that in every instance he should respect the local government, wherever or whatever it might be, as that he should destroy pirates.

The president of Porter's court was Commodore Barron, of Chesapeake notoriety. Some seventeen years before Barron had been tried for misconduct while in command of the *Chesapeake*, and had been sentenced to suspension, for five years. Porter had been a member of Barron's court. Captain John Downes, who had been Porter's first lieutenant aboard the *Essex*, was a member of the court that tried Porter.

Throughout the trial the court treated Porter with great tenderness. They were in full appreciation of the greatness of his past services, and his eminence and fame as a naval officer. But from the evidence produced before them, and the very nature of Porter's defense, any other verdict than that of "guilty as charged," was utterly impossible. He undoubtedly had landed in military array, and had committed hostile acts on the territory of the king of Spain. He had written disrespectful letters to his superiors, and he had published the proceedings of the court of inquiry before they had been acted upon by the Secretary of the Navy.

To have justified Porter would have given the power to make war, or bring the country into war, to every naval officer acting in independent command.

In recording its verdict the following was added: "the Court, however, feels itself called upon to ascribe the conduct of the accused, which is deemed censurable, to an anxious disposition on his part to maintain the honor, and advance the interests of, the nation and of the service."

To his dying day Porter never accepted the justice of this verdict. He was sentenced to six months' suspension from duty.

He resigned and spent four years as commander of the Mexican Navy. While there two attempts were made to assassinate him. Once, when travelling in a lonely country road, seven men attacked with murderous intent. He killed two of them, and put

the rest to flight. On another occasion, while asleep in his bed, two assassins tried to murder him. He killed one of these. Truly, this man was a fighter.

Porter returned to America in 1829. Two weeks after Andrew Jackson had been inaugurated President, he sent to Porter, offering him diplomatic service. It is evident that Porter was a man after Jackson's own heart. Porter was sent to Constantinople as consul general, and later raised to the rank of minister resident, remaining there till his death, in 1843. His life at Constantinople was full of happiness and honor, though at heart he was the naval officer. He was always the valiant American, patriotic and faithful, and resourceful to an extraordinary degree. If he did commit a grave error, it was the only one in a life full of responsibility, and surely his great services counterbalanced it.

U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

THE REALITIES OF BATTLE: WEAKNESSES, HEROISMS, PANICS.*

By General Daudignac, of the French Army.

Translation by Lieut.-Col. W. W. Gilbert, U. S. Army.

(Reprinted from the *Journal of the United States Infantry Association.*)

Whoever limits his military studies to historical narratives, like those of Thiers and Jomini, will acquire only a very imperfect idea of a real battle.

He will perceive the plans of campaigns, the movements of divisions, and sometimes those of a few battalions, but very rarely those of companies. He will view successful attacks but observe scarcely anything of partial defeats and their causes. He will perceive some heroic features, but never the weaknesses, although they are there.

Yet it seems as if it might be of some service to become acquainted with the thoughts of the chief actors (commanders and soldiers), their action upon others and their struggles with themselves. All this vanishes in these big volumes, and only the striking lines and contours of events, in which thousands of human beings participated, are perceived. It is a much worn coin from which the image has disappeared.

Therefore to understand a battle something besides the great historians must be studied.

For the history of the Revolution and of the Empire, the memoirs of eye-witnesses must be searched. For contemporaneous military history, chiefly the monographs and recollections written by officers must be read.

Since 1870 the French historical school has not omitted to consider the emotions of combatants, and, while presenting the

*From the *Bulletin de la Presse et de la Bibliographie Militaires*, (Bruxelles).

general features of operations, to sometimes descend to the movements of small units. It utilizes official reports as well as statements of eye-witnesses.

But if one desires to look into the thoughts which agitate a human soul subjected to the emotions of a battle, he will read the "Souvenirs de Sebastopol," written by Tolstoï, and also his great historical romance, "La Guerre et la Paix."

The pages of the Russian philosopher, who in his youth was an artillery officer and as such participated in the defence of Sébastopol, with those of Ardant du Picq, are the most thrilling writings upon the inmost thoughts of combatants, the psychology which brings success or disaster.

General Dragomirov affirms that the military pages of Tolstoï constitute the most useful appendix that could be added to a course in military art.

The author endeavors to produce a similar appendix in discussing the psychology of battle.

EXAMINATION OF THE PRINCIPAL PHASES OF A BATTLE.

BEFORE THE ENGAGEMENT.

In relation to this phase, General Trochu writes:

"Battle in its reality is a thrilling drama. It profoundly moves the human soul and, even when the soul is prepared by generous aspirations, education and habit, subjects it to manifold, variable, and unexpected tests. Those which assail officers entrusted with different grades of command and proportional responsibilities, differ from those which affect the general mass of combatants; but all have their share of them, and the heaviest naturally rests upon the commander-in-chief.

"Face to face with these tests men are very unequal to each other, and it often happens that they are very unequal in respect to themselves, that is to say, in respect to what they have been in other battles. This is because energy, heartiness, bravery and intelligence have their good and bad days. Family or business anxieties, mental or physical condition, excessive cold, excessive heat, weariness, hunger, and thirst exert an influence upon the disposition which each one brings to the struggle.

"It is known that in the wars of the Empire there was a difference between the valor when the Emperor was present and the valor when the Emperor was absent, of certain chiefs,

and that the confidence of the soldiers under the same circumstances rose or fell. This mental agitation, carefully repressed by each one, remains latent during the movements preceding the battle, and when the troops arrive at that zone in which the whistling of the first shells, shot from a distance and as yet badly directed, gives notice that peril is near, its traces are made manifest by a *profound silence.* This is the moment for the chiefs to influence the minds of the troops to whom they must present a serene countenance, and, with vibrant voice, address them in inspiring words. At this moment Napoleon was accustomed to pass along the front of lines ready to enter into action, and found words which electrified the soldiers."

These moments preceding the engagement are peculiarly poignant. Doubtless each man is resolved to perform his duty but he reckons that his life is in peril and his flesh quivers.

The bravest and most renowned do not escape these emotions. The words of Turenne addressed to himself at the beginning of a battle are recalled: "You tremble, carcass; you would tremble much more if you knew where I am going to take you presently."

Skobeleff himself, to select one of the bravest, was not exempt from emotion. The Russian painter Verestchagin * who had been authorized to accompany the military operations of 1877 in Bulgaria, recounts the following in relation to him:

"I admired in Skobeleff a nature entirely extraordinary, always impassible even in the most perilous moment. One day I expressed to him my admiration. 'It is nonsense,' he replied, 'to believe that I am a brave man and that I am afraid of nothing. I confess that I am a coward. Every time that I go into battle I say to myself that it will be my last.' I was gratified to learn that Skobeleff himself by no means looked upon death with indifference, but that he had learned to hide his emotions. I am now convinced that no man is entirely calm under fire."

MARCH TOWARD THE ENEMY.

At length the movement toward the enemy begins; the low grounds or the covers which screened from the view of the enemy are left behind and the troops move in the directions indicated.

*Verestchagin was also authorized to accompany the maritime operations of the Russo-Japanese war. He found death on the *Petropavlosk.*

We are going to see the difference between an order issued and the result obtained, by investigating how the emotions of the combatants influence the execution of the order.

For example, let us select an episode in the battle of August 16, 1870, the debouch of the 6th Prussian Division, in the forenoon, in front of the villages of Vionville and Flavigny, occupied by the French.

Let us first consider the order, and afterwards its execution.

The 6th Division, coming from Gorze, has arrived near Tronville. It is assembled, by brigades side-by-side, in a bottom 500 meters from the village.

The division commander issues the following order: The two brigades are to advance; the 12th Brigade will march upon Vionville, the 11th Brigade upon the height to the south of Vionville and thence upon Flavigny.

The movement begins. Let us accompany the 11th Brigade. The two regiments are behind one another, the 35th Regiment in front, the 20th Regiment behind the 35th. In each regiment the three battalions are on the same line, each battalion in double open column.

The deployment is superb and of perfect regularity as if on the drill ground.

But they arrive over against the cemetery, upon ground entirely exposed to the enemy's view. Then everything becomes disordered. Assailed by French cannon-shot and infantry fire, established at Vionville and Flavigny, the Prussian companies attempt to deploy. They turn under the fire, become confused, lose the direction, and fleeing from the exposed spaces, steal towards the parts of the terrain where they believe there is shelter.

In twenty minutes after their departure from Tronville in such excellent order, the 35th, instead of being in regular combat formation, is broken up into three unequal groups separated entirely from each other. One, consisting of five companies, is in the ravine in front of Flavigny; another of two companies, behind the cemetery. The third, of five companies, in the depression of ground between Vionville and the cemetery; there are also with these, two companies of the 20th. This regiment, which is in the second line, stopped before occupying the height.

Why are they in these places and not elsewhere? By the will of the commanders? Not at all. The men went there of them-

selves because these points, relatively to the French fire, are in a dead space. The fire caused the emptying of the exposed places.

Exposed to intense danger and under a shower of bullets, man yields to the instinct of self-preservation. He no longer advances but buries himself in every hollow of the terrain and behind any shelter where he believes himself secure. He does not reflect. He gets as well behind a hedge, which bullets can penetrate, as in a hole. He is looking for cover. The commanders are powerless to get him out. The co-operation of other fractions or other arms, the arrival of reinforcements, are necessary.

And indeed, the 11th Brigade will not carry alone the hamlet of Flavigny. This will not be accomplished without the co-operation of the 12th Brigade. The latter easily took possession of Vionville which was badly defended, and is debouching from that village upon Flavigny, and coming to give heart to the halting infantrymen of the 35th. The latter are gradually reassured by the sight of advancing comrades and by the noise of the several Prussian batteries occupying the crests farther south and firing upon the French. Only now do the men of the 35th regain courage and dash upon Flavigny, which the French have in a great measure evacuated.

The attracting power of shelter, the enticements of cover, are a fact which must be reckoned with in battle. It presents serious perils because it may, as has been seen, induce men to crowd together in clumps of trees, as at Loigny, and in hop fields, as at Froeschweiller, simple shelters which do not protect troops against bullets, but on the contrary render easier the task of the enemy by clearly indicating the place upon which he should direct his fire.

This same seeking for shelter or cover, arising from the instinctive sense of self-preservation, during the battle of Saint-Privat on August 18, 1870, gradually drew *43* German companies, belonging to seven different regiments, to crowd together in the rear of the Saint-Hubert farm, whose buildings furnished a dead space not reached by the fire of the French, established on the crest of the plateau of Pont-du-Jour.

The sheltered space is not large and those having taken refuge there are many. At about 9 o'clock, 5000 or 6000 men were there, and the expression of the German military writer Hoenig is appropriate when he calls this crowding together *an infantry mush.*

These 5000 men who are behind Saint-Hubert could by a dash carry the French crest which is only about 600 meters from them; but they will not rush over exposed ground, they no longer dare to advance or to retreat; they are demoralized.

They have crossed, not without trouble, the terrain exposed and swept by fire which separates the Mance ravine from the farm, and they want no more of it.

LEAVING THE HALTING PLACE FOR FIRING, AND ADVANCING.

Ground has been gained. An undulation of ground has been reached behind which a stop is made. Fire is opened and the enemy replies. It is very evident that further advance is necessary notwithstanding the rain of bullets.

Then a section* chief indicates another break in the ground which must be gained by a rush. He carefully designates it to his men. Then he hurls himself forward. Very often if the fire is severe, and even if it is not so, his men will not follow him, at least not all of them.

On August 16, 1870, during the engagement of the 38th Brigade (Wedell), of the 13th Division of the 10th Corps, the attack was directed against the French right towards the Cuve ravine. The southern crest of the Cuve ravine is approached. "I found myself," says Lieutenant Hoenig, "30 meters in the rear and on the right of the 12th and 9th companies of the 16th Regiment, near Lieutenant-Colonel de Roëll. At this moment Sergeant-Major Thiel, who was commanding a section of the 2d Company of the 57th, arrived from the left and made the following report to the Lieutenant-Colonel: 'I have the honor to report that my company will no longer follow me. The men are lying on the ground. I have rushed forward several times in vain. It has been of no use.'

"'The rascals!' exclaimed Lieutenant-Colonel de Roëll; then he said to me, 'Go with this section chief!' I reached the section and, thanks to the efforts of the brave section chief, some of the non-commissioned officers and men arose."

It might be supposed that all this had to do with extended order and that in the old column of attack of former days, of the times of close order to the limit, delinquencies were not possible.

An error.

*The French section corresponds to our platoon.

Colonel Ardant du Picq says in substance: "In a column covered by fire the number of men who voluntarily fall down by the way, letting themselves go at the slightest stumble, a kind of temporary desertion, is enormous. Half the men, and often more than half, fall down by the way. At Wagram, the famous attacking column of the Austrian centre numbered 22,000 men thrown forward: 3000, perhaps scarcely 1500, reached the position, and certainly the position was not carried by them, but by the material and moral effect of the great battery of 100 pieces.

"Then the 19,000 missing were disabled? No! A third at the most might have been hit. What had then become of the 12,000 missing? They had fallen down on the way and had pretended to be dead or wounded in order not to follow to the end.

"In so confused a mass of deployed battalions, where supervision is impossible and where the officers cannot stop to verify a pretended wound, nothing is easier or more common than this sort of defilade by inertia. The same thing occurs in every body of troops advancing under fire, in whatever order it may be, and the number of men who thus voluntarily fall out is so much greater as the discipline is less firm, as watchfulness on the part of chiefs and comrades is more difficult and as the soldier is less penetrated by the military spirit."

FLIGHT FORWARD.

Let us return to the time when the soldiers are firing halted. If the enemy's fire does them little injury, they are by no means anxious to advance. They willingly continue useless firing. The officers find some trouble in getting them up, especially when a man lying down is in this position almost secure but is aware that there is serious danger in exposing his breast to shots.

If on the contrary, whether standing or lying down, the soldiers suffer severe treatment, it becomes difficult to hold them in their places. They long intensely to get away. They must escape, to the rear or to the front. It is often of no concern whether it is forward rather than backward, or the contrary.

Let us suppose that they advance. The battalion has arrived within 100 paces of the enemy. If it has advanced resolutely, it is a wager of ten to one that the enemy has already retired, or will retire without further delay. But the enemy does not flinch. Then the man no longer masters himself, the instinct of self-

preservation absolutely governs him. There are two ways of shunning the danger; to flee or to rush forward. Let us rush. However little may be the distance, however short the moment separating us from the enemy, yet the instinct is apparent. We rush on, but the majority rush with discretion, with a backward sentiment rather, letting the more eager and bolder pass them, and the group becomes less compact as it approaches nearer.

THE ATTACK WITH THE BAYONET.

In an attack, the occupation of the enemy's positions is the sign of victory. It is the forward movement which decides it. The bayonet charge, coming after the firing, constitutes the movement demanded, the final struggle; and in this charge the public sees a clash, physical contact, exchange of blows and mutual slaughter.

In reality it is nearly always otherwise. "Outside of unexpected meetings," says Ardant du Picq, "for example in the storming of a village, where a small body of troops falls into a wasp's nest, no one in modern combat ever comes in contact with the enemy if he continues facing to the front. From the entrenchments at Fribourg carried by Condé, even to the bridge at Arcole stormed by Bonaparte, and even to Solferino, there are recorded numerous feats of valor and positions stormed in front in reference to which everyone is deceived. It is time that the people should learn that the entrenchments at Fribourg were not stormed in front, nor were the heights of Solferino.

"Let us analyze a bayonet attack. One body of troops is marching to close with another. The latter has nothing to do except to remain calm, and in readiness to aim, each man taking careful aim directly at the man before him. The attacking body arrives within unerring range. Whether it halts or not in order to fire, it will be always forestalled by the other which is waiting calmly, entirely ready and sure as to its action. The whole first rank of the assailants falls, riddled with shot, and the remainder, not encouraged by this reception, scatters of itself, or before the slightest demonstration of a movement against it.

"Do events occur in this way? No! Before the force of the assailants' moral energy, the assailed body is disconcerted, fires in the air or not at all, and immediately scatters before the assailant, who, emboldened by this fire having left him still standing,

redoubles his dash forward to avoid a second fire." This is a bayonet attack.

FEAR.

In all pictures designed to present trustworthy conceptions of battle, there should remain a trace showing that the soldier is not always brave.

Colonel Ardant du Picq says with brutal frankness: "*Man is afraid.*" He adds: "There are some commanders and some soldiers who are ignorant of fear; these are persons of a rare stamp. The mass is trembling, for the flesh cannot be suppressed."

The greater number moves forward just the same, but sparing of itself, and doing only what is strictly unavoidable, advancing only when it cannot do otherwise under the eye of the chief. Some brave men draw them along. And then, there are cowards; those who cannot or who will not resist the action of fear and who hide, fly or sink down abjectly. Fear manifests itself by two series of phenomena: with some by trembling or extreme agitation; with others by prostration or powerlessness; the majority of men are subject to its influence. This is why, at the battle of Cannes, 60,000 Romans were massacred by the soldiers of Hannibal. "Their weapons fell from their grasp," says the historian Polybius. It was a defenceless butchery.

Some men sink down as feeble as rags and permit themselves to be slaughtered like sheep. Some are timorous at the last; they have kept up for some time, but can no longer resist their fear; they have used up the dose of moral force at their command; they run away or lie down on the ground. Some are cowards who dare not advance and strive in every way to steal off without being seen. There are those who, while marching through forests, escape from their chiefs and hide in thickets; those who feign being wounded; those who offer succor to the wounded, in order to secure chances of remaining in the rear, those who voluntarily lose their cartridges so as to find pretexts for getting some from dead men, but who do not afterwards return; there is the soldier who, having galled his foot, cherishes his wound, in place of healing it, so as to be unable to march any longer, and the horseman who puts a stone in his saddle-blanket, in order to wound his horse, so that dismounted he may be forced to remain in the rear; all these things have been witnessed. There are those so

agitated that they fire without aiming and without even placing their weapons to their shoulders, making a noise only in order to reassure themselves; continuing an irregular fire until their rifle barrels burn their fingers. "Firing," says Colonel Ardant du Picq, "is the safety-valve of fear."

Finally, there is panic; and panic is yet more serious than individual weaknesses.

And as to the officers? They are of flesh and bone like the men; their bodies also tremble. But their greater moral force, through their training and through their wills, enables them to resist their emotions.

The first moments of battle are distressing; then they become occupied with their duties and no longer consider danger; they become used to it. An officer knows that he must set an example of courage. There are more deeds of heroism found among them than among the soldiers, and this is as it should be; but there are always some officers who do not prove equal to their duties; they have mistaken their profession; those who have not will enough to control their own nerves should get out of the army, for they cannot command; an officer who has already accepted the idea of sacrifice, must not be disturbed when the hour of payment arrives.

LESSONS.

From what precedes the following lessons may be drawn:

1. The morale of the soldier must be elevated in order to prepare him for the emotions of war.

2. In battle, the impossible must not be demanded of him. For example, marching over exposed ground against a hostile position not swept by fire, or executing well, at short range, aimed firing or volley-firing.

3. In battle, a man should be reassured by the comradeship of battle, by the connection between the arms; he should see echelons and supports behind him. General de Négrier says: "A line subjected to severe fire is very quickly shaken if its supports are not near enough."

4. Losses should be diminished through suitable formations; therefore thin formations should be adopted and the columns subdivided; but do not carry this beyond the group as constituted and detailed, without a sufficient lookout for ambuscades; there is nothing where there is no commander.

5. From a moral point of view, the formation by small groups or detailed swarms is better than a great line of skirmishers which does not support the weak and wavering, that is to say the majority, and which facilitates defilading.

THE QUESTION OF FIRINGS.

Let us now examine this man of flesh and bone, summoned to fire upon an enemy who is firing upon him.

When bullets hiss or crack about him, when shells burst with a shrill noise, when death is everywhere, visible and tangible, a profound distress takes possession of his whole being, the brute talks loudly and protests and the soldier is weakened in spite of himself. The psycho-physiological disturbances produced in him, in the presence of danger, as has been seen, are habitually expressed under the form of collapse or under the form of agitation. There is produced:

1. Enervation of the will muscles, trembling, arrest in movements, which thereby become disordered and feverish.

2. Checked respiration, oppression and restriction of the throat, from which result involuntary vibrations; man is no longer master of his organization.

3. There is spasmodic contraction of the vessels, paleness, afflux of blood to the heart, dilation of the pupils, etc.

What is the result? The irrigation of the cerebral cells being modified man is affected in his intellectual faculties, association of ideas is interrupted and power of judgment and attention diminished; the pupils being dilated, the image of the sight is no longer seen or seen only confusedly; the man aims with the front sight, nay, even with the end of the barrel, and he cannot give account of himself.

To sum up, man on the battlefield, dominated by his emotions, fires with haste, does not use the sight but aims with the extremity of his weapon and even pulls the trigger before having aimed. If this emotion becomes violent, under the agency of the instinct of self-preservation to which he becomes a slave, he fires without regarding where, and even without bringing his rifle to the shoulder; his bullets go into the sky or into the ground near him; he fires without reference to the orders of his chiefs, whom he no longer sees nor hears; he fires although there is no longer an enemy before him; he fires even upon his comrades who are in front of him. This is the firing of war.

These psycho-physiological disturbances of the man explain very clearly the difference between results on the drill ground and results on the battlefield. Who has not been impressed by the small number of men hit in a battle compared with the enormous amount of ammunition expended. Laws established through tests made on drill grounds are no longer applicable to war; they are no longer reliable at such a time. The efficacy of fire does not depend upon the greater or less accuracy of the elevation of sight selected by the commander or upon his technical skill in changing the groupings. In battle it depends primarily upon the mental condition of the marksmen. Let no one venture, under the enemy's fire, to mention sighting-practice or volley-firing. All the complicated science of determining the range by different elevations of sights, of adjustments, of telemeters, of probable percentages, will find application in war in only a few extremely rare cases, in which man has no danger to encounter and in which, admitting such conditions as possible, he will not be affected in the least degree, even if he knows (for example, when he is fighting savages) that the superiority of his weapons will insure him an easy victory.

THE EFFICACY OF FIRING IN TIME OF WAR DEPENDS FIRST OF ALL UPON THE MORALE OF THE COMBATANT.

From what precedes it should not be inferred that instruction in firing is useless; in the field it will always be advantageous to possess some clever marksmen if they preserve their coolness, and to have commanders capable of directing a fire and of firing to perceptible advantage with the instrument *man*, when he is not absolutely distracted by emotion. Instructed men will be always indispensable. Instruction of the marksman may strengthen the action of the morale on the battlefield, and even in a certain degree make up for its deficiency. As a result of training the muscles, of the coordination acquired in their contractions and the increased rapidity of nervous transmissions, the effort demanded for firing is considerably reduced. If emotion deprives a man of only a part of his abilities he may still aim, almost accurately, and utilize the physical powers which remain with him to secure approximate results, that is to say, to procure useful effects.

If the practical training which he has received has been carried forward to automatism, his emotion may become violent, his

dilated pupils may no longer enable him to discern the sight, he may become incapable of reasoning about his actions, he may quicken his shots and perhaps fire without calculation, yet his members, guided by habit, will nevertheless continue to operate with the regularity of peace times, his weapon will automatically point in the direction of the enemy, the extremity of the barrel will not become elevated, unconsciously he will bring it to his shoulder, aim and fire; he will still remain a formidable marksman.

Practical instruction thus carried to a very eminent degree has also an excellent moral influence upon the marksman. The man who is certain of his skill in firing comes upon the battlefield with confidence in himself, he is greater through consciousness of his strength and not so easily demoralized. The soldier must become an accurate marksman in order to acquire perfect confidence in his weapon; he must become at the same time a field marksman.

So much for the man; now some words for the platoon chief. The efficacy of fire depends not alone upon the end to be attained, the objective to be fired upon, the training of the marksman and the range of the weapon; it depends further upon the possibility of securing advantageous results; that possibility, depending entirely upon the moral energy of which men may be capable, changes everything. It is not enough for a chief to understand his business; he must also be a *psychologist;* he must be able to read on the countenances of his men the degree of tranquility of which they are capable, and the exact effort which he can demand of them. His rôle from a professional point of view is exceedingly important, but from a moral point of view, it is colossal.

From the moment when the chill goddess, *Fear,* penetrates within the marrow of the bones, when the flesh trembles, when each one is conscious that he is facing death, the officer has something better to do than to verify the sights or change the groupings; his mission is loftier. At a few paces behind his men, whom he has sheltered as much as possible, kneeling, or standing if necessary, he dominates them by his tranquil bravery; his eye is upon them, and by kindly words, even by a jest seasonably sprung, he heightens the energy of those who are experiencing the clutch of a sense of danger. He helps them in the conflict which they are maintaining against themselves; he assumes over them that moral ascendancy which great characters always obtain in deci-

sive crises, he holds them in his hand, he accustoms them to fire slowly, he prevents the elevation of the weapons. His moral superiority gives him an ascendancy which enables him to regulate and direct the fire of his men; his force of character creates discipline and efficacy of fire.

HEROISMS.

If there are weaknesses in battle, there are also heroisms. There are individual acts of heroism and also collective acts of heroism; entire bodies of troops, possessed by a frenzy of courage, have accomplished astonishing deeds, and fought to the end under difficult circumstances in which many others would have yielded in the face of superior hostile forces.

Among the more surprising achievements of collective courage there may be cited the battle of Diernstein, in November, 1805, in which the troops of the Mortier corps, completely surrounded by Russians, bravely cut their way through the enemy's ranks; and the battle of Fére-Champenoise, on March 24, 1814.

On the latter day two small divisions of infantry (Pacthod and Amey), after having passed the night at Sézannes, endeavored to rejoin another French corps in the direction of Etoges. They had a total effective of 4300 men, all, excepting a feeble battalion of the 54th line, national guards and conscripts, scarcely drilled at all, and characterized as *Maries-Louises*, officered, however, by old soldiers of Napoleon who were returning from Germany.

On the way they received an order to go to Fére-Champenoise and, as the Russian cavalry was beginning to appear and preparing to attack them, the troops formed in squares. They repulsed a first attack and resumed the march formed in six squares. They proceeded in this manner, with the squares disposed in oblique order in a way to cross their fires over all the faces and, continually harassed by the enemy's cavalry which was supported by horse batteries, they continued their retreat, surrounded by whirlwinds of cavalry. For over four hours they thus proceeded subjected to a fire of grape and canister and charged every quarter of an hour by the enemy's cavalry; yet not a square had been broken. The French generals, more surprised than the Russians themselves at the intrepidity of these soldiers in sabots and round hats, hoped to reach Fére-Champenoise.

When they came in sight of the heights commanding this town,

they discovered that numerous troops occupied them. They expected to have rejoined the Marmot corps, but this illusion was of short duration; the discharge of formidable artillery, which thins their ranks, announces the presence of a new enemy.

The retreat upon Féré-Champenoise having become impossible, Pacthod decided to gain the marshes of Saint-Gond; if he could reach them, he could defy all cavalry attacks.

The French now composed only four squares; three of the six squares, reduced to a very few bayonets, were merged into only one. They stoically began their march in the new direction and once more they penetrated the mass of horses. But at each step this mass increased; at last there were 20,000 of the enemy's horsemen and the French were now not more than 3000. Still they made 6 kilometers amid this tempest of horses. The enemy discontinued charging only to enable their batteries to overwhelm with shrapnel these intrepid battalions. After each broadside, the infantrymen closed up their ranks and received the horsemen with rifle shots or the bayonet. When the charge had been repulsed, they resumed their march. A single square broken by shot was routed. The three other squares were advancing to attain the marshes, when a regiment of cuirassiers and some batteries, which had easily outstripped them, entirely stopped them by the fire of 48 pieces.

The enemy offered them terms of surrender, but the soldiers were exasperated and drunken with powder, noise and blood; great-heartedly accepting their destiny, their thoughts were only of slaying or dying. They wished to neither receive nor give quarter. The savage and hopeless contest was renewed. The soldiers were unwilling to surrender; but Pacthod considered that, after a resistance so prolonged and valorous, his duty as commander forced upon him the sparing of what was left of his men.

He went out of his square, and advanced, wounded, to meet a new flag of truce. He demanded that the artillery cease firing and yielded up his sword. Soon afterward, the square of General Delort, battered by case shot on several sides, having expended all its cartridges, laid down its arms. The last square still resisted. A new volley of shot opened an enormous breach in the living walls; the cavalry entered sabering the separated soldiers who defended themselves hand-to-hand and strove to open for

themselves a passage to the marshes of Saint-Gond. Of the 4300 men who had accomplished seven leagues while fighting first against 5000 then against 10,000, then at last against 20,000 horsemen, supported by formidable artillery, but 500 were able to reach the marshes; 1500, a large number of them wounded, had surrendered after a desperate resistance; more than 2000 had fallen on the battlefield.

"There is not one," says General Delort in his report, "who did not surpass the demands of honor; but I cannot find expression to render fitting testimony. The epithet of brave men and heroes is powerless and forceless to represent an accurate conception of their behavior."

PANICS.

WHAT ARE PANICS?

Panic is a sudden relaxing, an accession of senseless terror, often inexplicable, which suddenly seizes an entire body of troops and, increasing with frightful rapidity, transforms it into a mob of fugitives.

HOW DO PANICS ARISE?

Almost always after a noise or an unforeseen danger. For example, at the end of a day of battle a body of troops is resting during a lull; it believes that for the time it is sheltered from all danger; suddenly the crack of a rifle shot is heard, only one; immediately ten men turn their backs and endeavor to hide themselves, a hundred imitate them and the whole body takes to flight. If it is not a rifle shot, it is any other unexpected noise, especially in the night; the galloping of a horse, for example. During the night in a camp, a sleeper preoccupied with the impressions of the day cries out in his dreams "To arms!" or some other alarming cry, and upon this false alarm the whole camp frantically hurls itself upon the rifles and begins to fire, without understanding upon whom.

If a panic occurs during an engagement it is caused by something suddenly happening, that is, by something unlooked for: an attack in the rear or on a flank; the unexpected appearance of a hostile force, superior in number; a trembler or an evil-disposed person who takes to flight crying out: "Sauve qui peut!" The latter trait chiefly appears in panics which occur in the rear of the

army or in the trains, where there are persons who are not soldiers, such as drivers, traders, etc.

Panics have occurred in all periods of time and in all armies; no occurrence is more frequent in the field and yet there is nothing of which the history of war makes less mention. It perpetuates, by only a few lines at the most, incidentally, the memory of such of these incidents as have acquired the greatest notoriety, without deriving therefrom any inference or any lesson; the panics of the enemy are especially mentioned and not those of the army of which one formed a part. For example, who in France is aware that on the night preceding the battle of Austerlitz, on the day following the battle of Solferino, and on the evening of Wagram, there were remarkable panics. The silence of war stories in respect to panics is, however, self-explanatory. "A faithful painting of scenes of confusion, such as are encountered at certain critical moments on the battlefield, would be, however," says the "Revue d'Histoire," "a precious fountain of reflections and teachings for those called to the honor of commanding troops."

Here is a list of the principal panics which have happened from 1800 to 1900:

1800: The Austrians at Marengo.
1806: The Prussians before Jéna.
1806: The French at Golymin.
1808: The Spaniards at Somo-Sierra.
1809: The French on the evening of Wagram.
1812: The French at Polotsk.
1812: The Russians at Borizow.
1813: The French at Vittoria.
1813: The English at Saint-Sebastian.
1814: The French at Arcis-sur-Aube.
1815: The English at Waterloo.
1831: The French (retreat of Médéah).
1859: The French (the day after Solferino).
1863: The Americans (at Chancellorsville).
1866: The Bavarians (near Fulda, Taxis division).
1866: The Italians at Custozza (Cérale division).
1870: The Prussians and French (several).
1877: The Russians at Sistowa (day after Plevna).
1891: The Italians at Adoua.
1897: The Greeks at Larissa.
1900: The Boers near Bloemfontein.

For the war of 1870-71, here is an enumeration of the principal panic episodes:

August 14, 1870.—The Prussians: Panic of nine companies near Lauvalliers, battle of Borny.

August 18, 1870.—The French: Panic of the Clérambault cavalry division, battle of Saint-Privat.

August 18, 1870.—The French: Panic of the Gibon brigade, 7th corps, battle of Saint-Privat.

August 18, 1870.—The Prussians: Two successive panics on the right wing on the evening of Saint-Privat.

September 19, 1870.—The French: Panic of a battalion of Zouaves at Châtillon, below Paris.

October 10, 1870.—The French: Panic in the Martineau-Deschenez division, of the 15th corps, on the evening of the battle of Artenay.

December 5, 1870.—The French: Panic near Motte-Beuvron (retreat of the 1st army of the Loire upon Vierzon).

December 9, 1870.—The French: Panic of the Maurandy division at Chambord.

December 28, 1870.—The French: Panic of the 17th corps (near Châteaudun).

January 11, 1871.—The French: Panic of the mobilized National Guard at Tuilerie (battle of the Mans).

January 29, 1871.—The French: Panic of the Thornton division at Chaffois (retreat upon la Suisse).

February 1, 1871.—The French: Panic of the 18th corps near the fortress of Joux (retreat upon la Suisse).

PRUSSIAN PANIC AT JÉNA, 1806.

(From the account of Colonel Massenbach.)

"On October 11, in the evening the Prussian forces were at Jéna, and the French advance guards were still at a distance. The Prince (Brunswick) was about to sit down at the table when suddenly a violent tumult arose; there was a cry that the enemy was only a short league distant. That was impossible, for our troops were on all the roads bordering the town and there was no report agreeing with such a rumor. Nevertheless it spread like a train of powder among the soldiers stationed around and within Jéna, and such was its effect that the Prince was compelled to go personally to put an end to it. The confusion was tremendous,

shameful. On every side was the cry that the French were arriving in force and that they had already driven in the outposts . . . . and evidently no one could say in what direction. On the road from Weimar a mob of soldiers of every arm was hurrying. Finally the panic so increased that the organization of patrols of officers for exploring the woods and the vineyards became necessary. It was asserted that all the environs of Jéna were already swarming with the enemy's skirmishers . . . . At the end of an hour, it was recognized that not a Frenchman was anywhere in sight, and that the alarm was started solely by some fugitives from the combats at Schleitz and Saalfeld."

These troops at Jéna had not yet been engaged.

FRENCH PANIC ON THE EVENING OF WAGRAM (JULY, 1809).

(*By the Russian General Loewenstern, Attaché at the French headquarters.*)

"The battle being nearly over, after having dined with comrades alongside of the tent of Napoleon, we resolved to return to Vienna. We mounted our horses in order to reach first the island of Lobau. We had scarcely gone a short quarter of a league, when some shots fired at the rear of the French army spread such terror among the stragglers and the wagon trains that they began to run, and communicated this terror to the reserves and the artillery train. Everyone ran to reach the bridges of Lobau. We still kept our heads; but very soon some outriders in the livery of Napoleon, having joined us at a fast gallop, cried out: 'Sauve qui peut! They are about to attack the headquarters of the Emperor!'

"Then the terror became so general that we were swept along by the fugitives. It was unknown from what quarter the danger was coming. The confusion was complete. Musket shots were fired on every side. The equipages of the generals and the carriages and wagons of the vivandieres were plundered by their own soldiers. . . . . Seeing a poor vivandiere lamenting that she was being robbed, I flew to her aid, but I came near paying dearly for my humane zeal. Some voltigeurs, after directing their muskets towards me point-blank, said to me: 'Skip or die!' I turned and left them, having no inclination to sacrifice my life without benefiting the victim.

"The confusion increased at every step and, recognizing the impossibility of gaining headway through the speed of my horse,

I decided to proceed at a walk and calmly and patiently await events. According to every probability, I said to myself, 'This panic terror can come only from the appearance of troops of the Archduke John; but where are they?' Only smoke and dust were visible; only cries and tumult were heard. At last a French general who commanded one of the approaches to the island met me. Seeing that I was calmer than the other fugitives and going at a walk, he asked me the meaning of this disorder after a battle won.

"I put the same question to him.

"'The Emperor, was he in danger?' he continued.

"'I do not know whether he is at this time; but I know that he was not ten minutes ago, for I had the honor of dining at the same table with the grand marshal alongside his tent?'

"Then he was reassured, and cried: 'They are rascals. I am going to fire shrapnel at them.' And he caused the gun to be fired upon the fugitives. For the moment the confusion only increased. But an order having been issued suffering no one to pass over the bridges, the fugitives began to accumulate on the bank and to stop. The dust diminished and, to their great astonishment, they saw that each one had been afraid of his neighbor and that there were no Austrians at all.

"We learned later that some Austrian lancers of the army of the Archduke John had appeared in the plain and caused this tumult. What might not have resulted from a bold advance by the Archduke John?"

FRENCH PANIC ON THE DAY AFTER SOLFERINO (JUNE 18, 1859).

A serious panic occurred in the rear of the French army on the day after the battle. Here is what M. H. Dunant, an eye-witness, recounts respecting it in his volume entitled "Un Souvenir de Solferino":

". . . . This panic was caused by an apparently very trifling circumstance. On the day after the battle, as each corps of the French army, after having taken position, got its bearings, convoys of Austrian prisoners were formed and were conducted towards Brescia. In the afternoon one of these detachments, escorted by Hussars, was advancing from Cavriana in the direction of Castiglione when, from a distance too great for its identification, it was foolishly taken by the inhabitants for the Austrian

army returning in a body. Notwithstanding the absurdity of this report, carried by peasants, teamsters and the small itinerant dealers who follow troops in the field, when the townspeople saw these individuals rushing into their midst panting with terror, they credited the ridiculous story. The houses were immediately closed, the inhabitants barricaded themselves in them, burned the tricolor flags which embellished their windows, and concealed themselves in their cellars or garrets. In the streets and the roads which are blocked with conveyances carrying wounded to Brescia, and trains for provisioning the army coming from that town, there are wagons driven at full speed, horses flying in all directions amid cries of rage and terror, wagon loads of baggage overturned and loads of biscuits thrown into the ditches bordering the highway. Finally the teamsters, influenced more and more by fright, unharness the horses and dash at full speed along the road to Brescia, spreading terror on the way, creating an incredible tumult, colliding with provision carts coming from Brescia, sweeping along with them everything that they encounter and trampling on the wounded, who entreat to be taken away and, deaf to admonitions, tearing off their bandages, totter from the churches into the streets not knowing where to go."

A short time afterwards, during the night of July 5, near Valeggio, another panic carried in confusion through the bivouacs a brigade of cavalry sent on reconnaissance.

PRUSSIAN PANIC (AUGUST 18, 1870, AT 6.30 P. M.).

(*From Hoenig: Twenty-four hours of strategy.*)

"On the evening of August 18, 43 Prussian companies, attracted by the cover provided by the Saint-Hubert farm, were huddled together pell-mell about the farm, which nearly screened them from the French fire. At about 6.30 in the evening, the redoubling of the French fire after a long lull, together with the advance of some companies in red trousers, created a violent commotion among these mixed troops, physically and morally exhausted. This confused mass, in which scarcely a single unit grouped under its commander was discernible, suddenly drawn from the relative quiet which it had for a time enjoyed, was seized with panic and began to drift back towards the bottom of the Mance ravine, already thronged with men separated from every corps. From the heights of Gravelotte (1200 meters from Saint-Hubert) the

spectacle was visible to the naked eye. It gave an impression that a French attack was advancing toward the eastern border of the forest and directing itself through this toward Gravelotte.

"The rapidity of the event, the cloud of dust preceding and following it, the confusion which was observed—these combined causes produced for a moment, upon the heights of Gravelotte, a feeling of dejection. Suddenly, over the whole front south of the highway at the western border of the forest, there was seen a '*bouillie*' of infantry, driven by panic and frantic with fear, hurling itself upon the line of Prussian artillery, which was ready to fire. At first glance it could not be distinguished whether these fractions were friends or enemies. The men were running forward impelled by fear, having lost all judgment and no longer retaining any moral control; they might as well have been Frenchmen.

"In the artillery line there was uneasiness and certainly a looking towards the rear; officers dashed forward to clear up the situation. They discovered that it was only German infantry which had lost its head. But in what a state! Morally spent, the men ran without knowing whither. The artillery officers galloped into their midst with drawn sabers; they cried to the fugitives that they would fire upon them with shrapnel, but without result. Men under such circumstances are incapable of reasoning.

"The officers, unable to reassemble these fragments, endeavored to direct them to the rear of the artillery front; that was impossible. Driven by anguish of mind, the fugitives ran in a direct line upon the German batteries and broke through them. They did not halt until far in rear of the artillery line. For the accomplishment of this, officers of every arm and generals as well as lieutenants exerted themselves. It was then about 7 o'clock in the evening.

SECOND PRUSSIAN PANIC (AUGUST 18, 1870, 7.30 P. M.).

(*From Hoenig.*)

"At about 7.30 p. m., a second breaking-up occurred in the rear of the Prussian line of battle. The 9th regiment of Hussars, which had been driven beyond the Mance ravine, found itself southeast of Saint-Hubert; it had been assailed by a hail of bullets so severe that the colonel had ordered the men to dismount. At this moment it was joined by a detachment of reservists of the regi-

ment, mounted on impressed horses and coming directly from Treves. Of these the colonel formed a 5th squadron which he placed alongside the others. But a new Prussian attack by the 32d Brigade upon Point-du-Jour having been repulsed, the firing increased in intensity. To withdraw his squadrons from this fire the colonel of the 9th Hussars ordered retreat to be sounded. The Hussars plainly saw their infantry execute an 'about face,' and the reservists, excited by it, immediately broke into a trot. The gait increased in rapidity; the horses which were not used to firing were frightened at the sound and ran away; the squadron adjacent to that of the reservists had been drawn along and set out with it, and all went toward Gravelotte at a headlong pace.

"To the great astonishment of the spectators near Gravelotte, the mass of horsemen debouched at a furious gait from the exit of the forest. At first everyone was chilled with fright. Their fear was greater because, as is known, they had just a little before witnessed a like panic on the south of the highway. A longer time was required to allay this. Animals move faster than men as they have more breath. The frantic horses flung themselves among the fragments of the different regiments which were just prepared to assemble on the highway. Upon the passage of the Hussars a part of the equipages of every kind and the led-horses made a sudden 'about face' and also dashed into the rout (panic of horses). Several officers threw themselves into the distracted crowd of men and horses and endeavored to stop them, but to no effect. Hussars, infantrymen of every corps, led and impressed horses, baggage and other wagons, all mingled together, violently opened a passage for themselves toward the rear. The confusion was indescribable. Men and horses had lost all sense; saber blows and imprecations glided over these frantic beings without moving them; the furious tide was stayed only when breath failed the men and horses and, naturally, they could be reassembled only far in the rear of the 2d corps. Several of the fugitives stopped only in the suburbs of Vionville, circulating everywhere these tidings: 'We have been defeated.'"

PANIC AMONG THE BOERS.

(*South-African War.—March, 1900.*)

After the surrender of Cronje at Paardeberg in February, 1900, there was profound dejection among the burghers. General

Christian de Wett in "Recollections of Three Years of War" recounts as an eye-witness the following:

". . . . I disposed the laagers formed by my commandos over a breadth of 12 miles along the river Moder. On March 7, Lord Roberts advanced towards the river, with his forces deployed over a front of over ten miles. But before the enemy had come within cannon-range, our burghers abandoned their positions in disorder. They fled, they fled, and not one of them restrained his comrades. I had never seen such a flight. Guns, carriages, wagons, burghers, all went down, tumbled down, threw themselves down headlong from their positions, in a most abominable pell-mell. With my officers I strove in vain to rally them. Nothing could be done. I was not able until the following day in part to reassemble them in a position nearer Bloemfontein. For a wonder the burghers maintained their ground with the greatest firmness from 10 o'clock in the morning until sunset against a fresh attack by the English. Had they realized the absurdity of their conduct on the previous day? Had they been led by my encouragements to believe that safety lay neither in fear nor in flight? I do not know. They held out until evening, but during the night they abandoned their positions. We assembled again 5000 of them south of Bloemfontein; but on March 13, at dawn, a commando quitted its post, and when the English attack occurred, the burghers began to weaken; then in the twinkling of an eye, from one position after another they took flight. The officers and I were unable to arrest the breaking up; toward the northeast it was the gallop of a hunted herd."

THEORY OF PANICS.

Why panics? Because the man is afraid. If he is in battle for hours and perhaps for days after he knows that the enemy is near, he contends against his instinctive fear until he has succeeded in repressing it. But at a sudden revelation of unforeseen peril, at the unexpected appearance of a powerful force which he believes cannot be overcome, he permits himself to be dominated by the instinct of self-preservation; he hides or runs away. If a dozen men simultaneously abandon themselves to this influence, since the majority is in the same mental condition and possesses the same sensibilities, they will find in the twinkling of an eye a hundred imitators, and panic begins. Then the troop becomes a

mob, with all the inferior qualities of a mob, now obeying only its instincts; a flock of sheep, like that at Panurge.

General Trochu is one of the few military writers who have discussed panics; this is his theory:

"Panic is the action of the instinct of self-preservation; it is instantaneously developed through the agency of the spirit of imitation which so easily sways agglomerations of men or animals. A crowd between whose different individualities there exists no affinity or bond, for example, a crowd of spectators, is proceeding in a long column towards some destination. The head of the column, swayed by either imaginary or justifiable terror, violently turns about and takes to flight. The middle and the hinder part of this column, which have perceived nothing and can discern nothing to occasion this unlooked-for volt, violently face about and flee in their turn.

"A herd of horses, left to itself, is grouped in a meadow. One becomes alarmed, suddenly turns about and bounds into a frightened gallop. All the rest imitate him and run off with him.

"In war, the phenomenon operates with irresistible energy upon masses whose elements are intimately united through military organization and habit and gives rise to serious disorders. When under some conditions, in the night for example, panic strikes a body of infantry carrying loaded weapons, great calamities are almost inevitable. All arms have encountered panics and will encounter them. Green troops are naturally more susceptible to them than seasoned troops, the degree of excitability of temperament also entering in as an element, but no one is exempt when his time comes; and public sentiment is on the wrong track when it jeers at troops who have yielded to panic, and when it seems disposed from this incident to pass judgment upon their steadfastness. Responsibility for it almost always falls upon the commanding officer. He has been lacking in moral weight, experience and foresight.

"Panic occurs only under the following circumstances:

"1. At night, in presence of the enemy. So every operation which, under such conditions, purposes to put in motion troops who perceive themselves environed by perils, evidently demands not only a choice of officers and soldiers but an infinite amount of foresight, precaution and advice to be bestowed.

"2. In the daytime, in presence of the enemy, after a defeat or

after a sharply contested action which has brought great losses, shaken the confidence of the soldiers, and left a painful impress upon their minds.

"3. At any time when the troops are so badly engaged in action in front of the enemy that they themselves are conscious of it and are expecting, and, as it were, are on the watch for, a danger which the imagination of a soldier always magnifies. For example, a numerous body of cavalry, reconnoitering in front of an enemy known to be near, is advancing in deep column over a road bordered by ditches and woods, where it perceives that its special activities are completely paralyzed and at the same time is expecting to see the woods become filled with hostile infantry-men. It is too far in advance to reckon upon the support of its infantry; its isolation disquiets it. A retrograde movement on the part of its scouts and its advance guard, an unlooked-for apparition among the trees, a pistol shot fired unexpectedly, the slightest unforeseen incident, may determine a partial retreat which soon brings on the retreat of the whole, in a confusion directly proportional to its number."

General Bonnal, considering a panic of two Prussian battalions at the battle of Borny on August 14, 1870, thus expresses himself respecting panics: "Panic is a phenomenon of collective nervousness originating in the psychology of crowds. The panic which suddenly seizes the men composing an armed force is generally occasioned by a very insignificant appearance of danger, but the troops must have been previously subjected to considerable enervating influence. As has been always observed, panics occur more frequently at the end of an engagement or on the day after than at any other time."

MEANS OF PREVENTING OR ARRESTING PANICS.

Panics are particularly perilous when a large number of horses are involved in them. If men do not reason under such conditions, animals reason still less, and as they possess force, mass, and quickness, they overturn everything, increasing the disorder by dragging everything along and preventing men from recovering themselves. Panics in which only infantry are involved are less dangerous as to duration, for if men yield to fear and rush to the rear, they are soon out of breath and must recover it. So their commander is given opportunity to detain them and bring

them back. But let there be no illusion that when a panic has actually gained possession of troops any effort can immediately arrest its effects. The much surer method is by striving to prevent its origin, and experience has demonstrated that in many cases this can be accomplished. The means to be employed for preventing panics are in a general way of three kinds: the moral training of the soldier, suggestion, and the foresight of commanders.

MORAL TRAINING OF THE SOLDIER.

The soldier must receive a vigorous moral training. This function devolves upon the officer; his agency will be powerful and effective, on condition, however, that the primary school, working in the same line, has already awakened in the minds of the young men ideas of duty and of country. Moral training should conduce to the development of all those faculties of men which are in harmony with the soundest and manliest requirements of war:

Sentiments of duty and of honor.
Conviction of the utility of discipline.
Love of country.
Willingness to perform duty.
Daring and contempt of peril.
Self-respect.
Spirit of devotion and sacrifice.
Confidence in commanders.
Comradeship in battle.

SUGGESTIONS.

There are several ways of suggesting an idea to anyone; but whatever means are employed, the first requisite is earnestness; one cannot inspire another with ideas unless he firmly holds them himself. There is no need of the technical methods of the hypnotist, but of methods within the reach of everyone. I refer to words, looks, example and will. The soldier must be convinced that he must march notwithstanding weariness; it must be suggested to him to advance notwithstanding rifle shots; he must be persuaded that he has a duty to fulfill in order to give victory to his country, and to that end it must be often repeated and affirmed to him that his officers will set him the example. Does not the well-known episode of General Chevert at the siege of

Prague, in 1757, furnish an illustration of suggestion? He wished to carry a passage occupied by the enemy, but the enemy is on the watch; it is necessary to assault without delay and first to get rid of a sentinel guarding the approaches.

He sends for a grenadier and indicates to him the mode of his procedure.

"At the top of the parapet, you will find a sentinel."

"Yes, my General."

"He will fire on you and will miss you."

"Yes, my General."

"As for you, you will not miss him and we will come to your aid."

"Yes, my General."

And it turned out as suggested.

Are not the discourses of Souvarow to his soldiers, for the purpose of implanting in their heads and hearts the idea that *the art of conquering is the art of becoming accustomed to slaying*, of the nature of suggestion? But not only individuals are to be influenced by suggestions, but the mass, the crowd. And this can be realized since a crowd is readily influenced and right or wrong ideas spread through it with wonderful rapidity. The commander must convince the crowd—that is, his troops—that he holds victory in his grasp. What is generally a lost battle? It is a battle believed to be lost. Definitely, it is an affair of morale.

To suggest victory to his soldiers the commander must will it. Let his will be stronger than that of his enemy and let him inspire this will in his troops by attitude, gesture, word and action. Illustrations of this are:

Davoust at Auerstadt, in 1806, advancing, always advancing, although the main body of the Prussian army was before him, and repeating to his soldiers: "Victory is not to the big battalions but to the more stubborn."

Changarnier at the retreat from Constantina in 1836, saying to his battalion, charged with guarding the rear and harassed by thousands of mounted Arabs: "We are 600 and they are 6,000; it is an equal match."

General Alvensleben, on August 16, 1870, with two Prussian army corps, running into the main body of Bazaine's army but believing that he was only encountering a rear-guard, boldly assumes the offensive, deceives his adversary by his attitude,

attacks, always attacks, so leaving it to be inferred that he would be supported by other corps, although there were no others.

On the evening of the same day, at 9 o'clock, Prince Frederic Charles of Prussia hurling divisions of cavalry upon the front of the French army at a time when, the fire having already ceased, it was thought that the day's work was ended, thus seeking to display superior moral energy and to declare his determination to conquer.

All this illustrates that the action of commanders determines victory. It is accomplished by means of suggestion. In order to convince others by action one must be first self-convinced that he is a conqueror because he resolves to be one (auto-suggestion). Resolve first, suggestion afterwards; these are two essential factors of victory.

FORESIGHT OF COMMANDERS.

Capacity to foresee is essential to commanding well. "When troops yield to panic," says General Trochu, "the responsibility for it falls upon the commander, for nearly always he has been lacking in moral influence, experience and foresight."

What, therefore, should the commander do? He should avoid placing his troops under conditions which physically or morally dispose them to yield to the power of panic. He should therefore spare them all useless fatigues; he should guard them against any surprise whatsoever, for surprise engenders demoralization. Surprise, in the broad sense, as in the strict sense of the word, is an unlooked-for apparition of a danger against which an adversary will not have time to guard, or can guard only inadequately.

When a sense of impotence resulting from such a situation steals into the soul, it disarms and paralyzes it. This mental fear, much more terrible than physical dread, invading the most manly breast, chills it and persuades it that it is vanquished, or can no longer vanquish, which is the same thing. In respect to a panic, the commander should admonish the soldiers of what may happen. He recommends coolness and tranquility. He explains to them beforehand why and how they may be assailed by a sudden fright, to which they must not yield. He analyzes and causes them to comprehend the unsound impressions which create the phenomenon; he teaches them by illustrations the peril of it from the point of view of common safety, and the absurdity of it from the point

of view of military self-respect. "Troops so prepared," says General Trochu, "are not accessible to panic. They escape it absolutely when the experienced commander, seeing the conditions which ordinarily produce it almost realized, opportunely renews his lesson with added warning especially appropriate to the environing facts, and so fortifies beforehand the minds of his men to encounter surprises."

Note under what circumstances, General Trochu has accomplished what he claims. Some days after the panic at Solferino, on July 5, the Trochu division was bivouacked on the front line near Vallegio. The general was notified by an ordnance officer that two regiments of cavalry would pass in the night time, in front of his troops, starting on a reconnaissance. "How?" cried he. "After the panic of the other day do you need another at night? Is that a time for making reconnaissances by cavalry, and, what is worse by entire regiments? At night! Do you not know what cavalry at night signifies? The horses are constantly restless and the riders doubtful of themselves. The fall and discharge of a pistol is sufficient to throw everything into confusion":

"It is possible, my General," replies the officer, "but I can do nothing about it. I am simply directed to notify you."

The general returned to his tent and immediately drew up the following general order:

"Soldiers, to-night you will probably hear shots, cries and calls; then you will see a frightened body of cavalry pass by. Whatever happens, I expressly order that the stacks of arms shall not be broken; that under no pretext whatever shall the men take their weapons, and I hold the captains personally responsible for the strict enforcement of this general order."

The order was immediately communicated; officers and soldiers wondered what insect could have stung their general. At 2 o'clock in the morning the men who were sleeping were awakened by an uproar and frightful outcries; a confused avalanche of men and horses rushed upon the bivouac with the cry: "They are following us!" They overturned the general's tent and most of those of the officers, they upset men and stacks of arms, and finally disappeared in the shadows of night like a nightmare. The infantrymen of General Trochu, who had just finished two battles, were not novices, yet they rushed nervously and tremblingly upon

their stacks of arms, and all the force of discipline and all the confidence reposed in their commanders were demanded to prevent them from seizing their weapons and firing at random. The general's foresight had prevented panic from taking possession of his troops.

General Lebrun was certainly inspired by the memory of this incident of the war of 1859, when on August 22, 1870, being commander of the 12th corps of the army of MacMahon, he issued the following instructions:

"The generals will assemble, as soon as possible, the officers under their orders and request them to put their troops on guard against the perils of panics; they will demand from each battalion chief responsibility upon his honor that, in case of alarm, his soldiers will not break the stacks of arms before he has ordered them to do so. At the first outcry in front of his battalion, creating apprehension of a panic, he must with a loud voice direct all his men to remain lying down at the foot of the stacks, until he commands them to rise. He must, moreover, command the respect of his troops by a tranquil attitude and, when necessary, by a few vigorous words."

These are the principal methods of averting panics. A multitude of precautions which an experienced commander should know how to exercise should be added; they are of value because they may contribute to prevent demoralization. These for example:

To cause the wounded, the sight of whom is always painful, to be quickly removed. To gain ground if possible. To order the artillery when retiring, to never leave a combat position excepting at a walk. To keep the horses apart by themselves when possible. During a battle, to place in rear of the army troops, generally gendarmerie, specially charged with arresting fugitives and stragglers.

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U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

NAVAL ADMINISTRATION, 1842-1861.

By CHARLES OSCAR PAULLIN.

THE NAVY DEPARTMENT.

The first period of the naval bureaus lasted almost two decades, from the organization of the bureaus on September 1, 1842, until March 5, 1861, when Lincoln's Secretary of the Navy, Gideon Welles, entered upon his duties. The principal work of the department during this period had to do with the construction of a steam fleet, the improvement of the naval personnel, naval voyages of exploration, the operations of the Mexican War, and the disturbed relations between the North and the South in the winter of 1860-1861. The list of naval secretaries for this period contains but few illustrious names. They were upon the whole men of less ability than were their predecessors under the navy commissioners. The succession of secretaries was as follows: Abel P. Upshur, of Virginia, 1842-1843; David Henshaw, of Massachusetts, 1843-1844; Thomas W. Gilmer, of Virginia, 1844; John Y. Mason, of Virginia, 1844-1845; George Bancroft, of Massachusetts, 1845-1846; John Y. Mason, of Virginia, 1846-1849; William B. Preston, of Virginia, 1849-1850; William A. Graham, of North Carolina, 1850-1852; John P. Kennedy, of Maryland, 1852-1853; James C. Dobbin, of North Carolina, 1853-1857; and Isaac Toucey, of Connecticut, 1857-1861.

During the twenty years preceding the Civil War, the naval affairs of the United States were largely under the influence of Southern men. In Congress, probably no one man so much determined naval legislation as Stephen R. Mallory, of Florida, who in 1861 became the Secretary of the Navy of the Southern Confederacy. For several years he was chairman of the Senate Committee on Naval Affairs. Of the eleven secretaries named

above, all except three, Henshaw, Bancroft, and Toucey, came from States south of Mason and Dixon's line. The joint service of Henshaw and Bancroft was only two years; and Toucey, Buchanan's naval secretary, was a Southerner in his sympathies. Of the eight Southern secretaries, three were from North Carolina, four from Virginia, and one from Maryland. They were all lawyers, and most of them had served in Congress. They had few practical or technical qualifications for the secretaryship. Toucey also was a lawyer, and had been attorney-general and later a senator of the United States. Bancroft was an historian; and Henshaw, a sometime druggist, a promoter of railroads, and a Massachusetts politician. Henshaw was commissioned during the recess of the Senate on July 24, 1843. President Tyler sent his nomination to the Senate on December 6, which body rejected it on January 15, 1844, it is said, for political reasons. This is the only instance in which the Senate refused to accept the President's choice of a Secretary of the Navy.

Henshaw's successor, Thomas W. Gilmer, performed the duties of his office for only ten days. Both he and Ex-Secretary of the Navy Upshur were killed on February 28, 1844, by the explosion of a gun on board the naval steamship *Princeton*. This vessel, which had been just completed, was fitted with improved machinery and guns. She was a screw-propeller, and her two largest cannon fired balls weighing 225 pounds each—a great weight of metal for that day. She was brought up the Potomac to Washington in order that the officers of the government might inspect her. On the morning of February 28 a large company of invited guests, drawn chiefly from official life in Washington, went on board the vessel. She proceeded down the Potomac below Mount Vernon. The accident occurred on her return trip, after she had made a most excellent showing of her machinery and guns. The guests had just refreshed themselves with a "sumptuous collation," and were seated around the table when word was sent them that one of the guns was to be again fired. The gentlemen of the company led by President Tyler immediately went on deck, but fortunately the President was called back and escaped death. The gun burst, killing all that stood near it. Among the dead were Gilmer, Upshur, Commodore Beverly Kennon of the navy, and Mr. Virgil Maxey of the diplomatic service.[1]

[1] Benton, Thirty Years' View, II, 567-569.

George Bancroft and John P. Kennedy may be classed among the literary Secretaries of the Navy. Bancroft's "History of the United States" is well known. Less familiar to most readers and doubtless less deserving to be remembered, is a slender volume of poems that he published in his youth. Bancroft has been tersely described as "learned, full of semi-poetic fire, something of a popular orator, and a sincere democrat."[2] In the midst of his legal and political duties, Kennedy found time to compose several volumes of pleasing fiction and a biography of William Wirt. No more genial, cultured, and sweet-spirited man than Kennedy has filled the secretaryship. Like Paulding, he was an intimate friend of Washington Irving, who in 1853, when collecting information for his "Life of Washington," was the guest of the Secretary at the capitol. Irving was quite taken with the Navy Department and discovered much poetry in its materials and incidents. Kennedy regarded it as much the most interesting department of the government.[3]

A friendly pen has written concerning Kennedy that the "versatility of his usefulness and his sympathies may be inferred from the many and widely distant associations that endear his memory. His name gracefully designates a channel of the lonely Arctic sea, and is identified with the initial experiment which established the electric telegraph; with the opening of Japan to the commerce of the world; with the exploration of the Amazon and the China sea; with the benefactions of Peabody and the loyalty of Maryland; with the cause of education and the old genial life of Virginia; with what is graceful and gracious in American letters and useful and honorable in American statesmanship; with the pleasures of society and the duties of patriotism; with the fondest recollections of friendship and the tenderest memories of domestic love."[4]

Literary men when called to participate in the affairs of state are supposed to bring to their work a high sense of duty and an elevated view and purpose. The services in the Navy Department of Bancroft and Kennedy bear out this supposition. Bancroft manifested great zeal for naval education and a thorough-going reform of the naval personnel; while Kennedy

[2] Trent, American Literature, 542.
[3] Tuckerman, Kennedy, 235.
[4] Tuckerman, Kennedy, 21-22.

was chiefly interested in the scientific work of the navy, and took much satisfaction in the aid which he was able to give to naval voyages of exploration.

The characters of Bancroft and Kennedy are more interesting than those of the other secretaries from 1842 to 1861. All showed a fair degree of zeal and industry in their work; but none, with the possible exception of Bancroft, achieved distinction. For one reason their terms of office were short. Only Dobbin, 1853-1857, and Toucey, 1857-1861, served for the full four years. The services of Mason, whose two terms were separated by that of Bancroft, amounted to three and a half years.

The lives of several secretaries after they resigned from the department are interesting. Gilmer left Fillmore's cabinet to become the candidate of the Whig party for Vice-president on the ticket with General Scott. During the Civil War he was a member of the Confederate Senate. Preston, President Taylor's naval secretary, also served in that body. Bancroft and Kennedy, one a Democrat and the other a Whig, ardently espoused the cause of the Union. When Toucey, Buchanan's secretary, yielded his office to Gideon Welles on March 5, 1861, he returned to Hartford, Connecticut, to the practice of law, where he remained during the war.

From 1842 to 1861 no settled policy was followed as respects the designation of an acting Secretary of the Navy, an officer appointed to take charge of the department during the absence of the secretary from Washington. The chief clerk of the department, the chiefs of bureaus, and the Secretary of War at different times served in this capacity. In June, 1853, Jefferson Davis, who was then Secretary of War, was also acting Secretary of the Navy. Twice a Secretary of the Navy *ad interim* was appointed. In 1844 Commodore Lewis Warrington, when chief of the Bureau of Navy-Yards and Docks, and again in 1859, when chief of the Bureau of Ordnance and Hydrography, was so designated. The chief clerks of the department were no longer chosen to act in this capacity.

In the fall of 1841 Secretary Upshur took up the subject of naval administration, and discussed it at some length in his annual report for that year. He believed that a reorganization of the department was indispensable, and that it could not longer be delayed without serious injury to the service. The following

extract from his report contains the gist of his criticism of the old navy system:

"I have had but a short experience in this department, but a short experience is enough to display its defects, even to the most superficial observation. It is, in truth, not organized at all. The labor to be performed, must, under any circumstances, be great and onerous, but it is rendered doubly so by the want of a proper arrangement and distribution of duties. At present a multitude of duties are imposed upon the head of the department, which any one of its clerks could discharge as well as himself, but which from their pressing nature, he is not permitted to postpone. Hence, his whole time is occupied in trifling details, rendering it impossible for him to bestow the requisite attention upon more important subjects involving the great interests of the service. These details are, indeed, so numerous and multifarious, as to constitute in themselves an amount of duties fully equal to the powers of any one man. In addition to this, the present want of proper arrangement is extremely unfavorable to that individual responsibility, which it is so necessary to impose upon every public officer. The same cause occasions delays in the operations of the department by rendering necessary a variety of tedious official forms, and consequently preventing that promptness of action which is indispensable to its due efficiency. And it is not the least among the evils of this state of things that the precise condition of the several branches of the service cannot be ascertained without much time and labor; thus adding to the cost of the department, while it diminishes its usefulness. These inconveniences and embarrassments, and many others which are daily felt in the administration of the department, would in some degree be removed by a mere rearrangement and proper distribution of the labor now employed in it; but additional labor is absolutely necessary in order to enable it to discharge its functions in the manner required by the interests of the service."[3]

These thoroughgoing criticisms reveal a secretary new to his office and ardent for reform. Upshur's next step was to draft and send to the House a rough sketch of a bill for the reorganization of the department. With this as a basis, the House by March, 1842, had prepared a bill, which provided for six naval bureaus; navy-yards and docks; construction and repairs; equipment, provisions, and stores; ordnance; hydrography; and medicine and surgery. Upshur recommended that the duties of the Bureau of Equipment, Provisions, and Stores be vested in two bureaus instead of one. Accordingly on June 17, 1842, William S. Archer, of Virginia, introduced a bill in the Senate providing for seven naval bureaus. This passed the Senate on August 6. After being amended, it was passed by the House on August 30. Two of the amendments of the House are important: one united

[3] Ann. Rept. of Sec. of N., 1841, p. 378.

the Bureau of Equipment with the Bureau of Construction and Repairs, and the Bureau of Hydrography with the Bureau of Ordnance; and the other vested the power of appointing the bureau chiefs in the President and Senate instead of in the Secretary of the Navy. This bill became a law on August 31, 1842.*

The most significant fact about this legislation for the reorganization of the Navy Department is that the act of August 31, 1842, contained no provision organizing the chiefs of the bureaus into a board and vesting it with corporate functions. The division of labor among the bureaus was complete. Each chief was individually responsible to the Secretary of the Navy; all collective responsibility was abolished. The only unifying factor in the department was the Secretary of the Navy. The new act specifically repealed the law establishing the Board of Navy Commissioners. In place of the board it substituted five naval bureaus, whose names are as follows:

1. Bureau of Navy-Yards and Docks.
2. Bureau of Construction, Equipment and Repairs.
3. Bureau of Provisions and Clothing.
4. Bureau of Ordnance and Hydrography.
5. Bureau of Medicine and Surgery.

The law prescribed that the chiefs of the Bureaus of Navy-Yards and Docks and Ordnance and Hydrography should be captains of the navy, and should receive an annual salary of $3500, in lieu of all compensation whatever as naval officers. The chief of the Bureau of Construction, Equipment and Repairs, who must be a skilful naval constructor, was to receive the same salary. The chief of the Bureau of Provisions and Clothing was given $3000 a year, and might be either a naval officer or a civilian. The chief of the Bureau of Medicine and Surgery, who was paid $2500 a year, was to be selected from the surgeons of the navy. The several chiefs were to be appointed by the President and confirmed by the Senate.

The naval bureaus were subordinated to the Secretary of the Navy by the enactment that "all the duties of the said bureaus shall be performed under the authority of the Secretary of the Navy, and their orders shall be considered as emanating from him, and shall have full force and effect as such." No change in

* Congress Letters, VIII, 362; Congressional Globe, 1841-1842, pp. 854, 970-973; U. S. Statutes at Large, V, 579-581.

the Secretary's office, except in its clerical force, was made. To it was assigned a chief clerk at $2000 a year, and nine other clerks with annual salaries ranging from $800 to $1500. The Bureau of Navy-Yards and Docks was allowed a civil engineer, a draftsman, and three clerks; the Bureau of Construction, Equipment and Repairs, a draftsman and four clerks; the Bureau of Provisions and Clothing, three clerks; the Bureau of Ordnance and Hydrography, one draftsman and three clerks; and the Bureau of Medicine and Surgery, an assistant surgeon and two clerks. The annual salaries of the clerks of the bureaus ranged from $800 to $1400. Officers in the navy might be appointed to clerkships. The books, records, and papers of the navy board were ordered to be distributed among the several bureaus.

The Secretary of the Navy was authorized to assign such duties to the five bureaus as he should judge expedient and proper. The names of the bureaus indicate the duties that were assigned them. The Bureau of Navy-Yards and Docks was vested with the construction and maintenance of the docks, wharves and buildings within the navy-yards. It was given a general control of the administration of the yards. The several commandants reported to the chief of this bureau. The Bureau of Construction, Equipment and Repairs was charged with the designing, building, fitting, and repairing of wood and iron hulls; and with the equipping of vessels with sails, anchors, cables, fuel, galleys, blocks, and yeomen's stores. The Bureau of Provisions and Clothing provided the navy with provisions, clothing, and small stores. On shore, its agents were the navy agents and storekeepers; and on shipboard, the pursers. The duties of the Bureau of Ordnance and Hydrography related to the maintenance of magazines, the manufacture and use of ordnance and ammunition, the issuing of naval charts, and the collection and dissemination of hydrographic information. The Bureau of Medicine and Surgery purchased medical supplies, and superintended the naval medical corps and the naval laboratories, hospitals, and dispensaries.

The bureau system was immediately put into operation. On August 31, 1842, President Tyler appointed Commodore Lewis Warrington, the president of the Board of Navy Commissioners, to be chief of the Bureau of Navy-Yards and Docks; Commodore William M. Crane, the second member of the board, to be

chief of the Bureau of Ordnance and Hydrography; and Commodore David Conner, the third member of the board, to be chief of the Bureau of Construction, Equipment and Repairs. Dr. William P. C. Barton, who stood second on the list of navy surgeons, was made chief of the Bureau of Medicine and Surgery; and Charles W. Goldsborough, secretary of the navy board, became the first chief of the Bureau of Provisions and Clothing. On the same day, August 31, these appointments were confirmed by the Senate. On September 1 the bureaus were organized.

The act of August 31, 1842, required that the chief of the Bureau of Construction, Equipment and Repairs should be a "skilful naval constructor." This provision was disregarded by Secretary Upshur when he appointed Commodore David Conner, an officer of the line, to be the first chief of this bureau. Upshur explained in his annual report for 1842 that in selecting Conner, he had preferred a naval captain qualified to equip, to a naval constructor qualified to construct and repair. This violation of the law, which was in the interest of the officers of the line, continued until 1853 when a provision was inserted in the general appropriation bill for that year and retained after considerable opposition, directing that the chief of the Bureau of Construction, Equipment and Repairs should "be a 'skilful naval constructor,' as required by the act approved August thirty-first, eighteen hundred and forty-two, instead of a captain of the navy."[1]

Early in 1843 an attempt was made in Congress to modify the act reorganizing the Navy Department so as to render civilians ineligible for the position of chief of the Bureau of Provisions and Clothing. The success of this attempt would have necessitated the retirement of Goldsborough. In September, 1843, Goldsborough died, and in December President Tyler nominated a civilian to fill the vacancy—Isaac Hill, of New Hampshire. The Senate refused to confirm this nomination. On January 30, 1844, the President nominated and the Senate confirmed a naval officer, Commodore William B. Shubrick. Gideon Welles, Shubrick's successor, was the last civilian chief of the Bureau of Provisions and Clothing. Since Welles's resignation in 1849, members of the naval pay corps, in accordance with law, have been regularly appointed to the chiefship of this bureau. In these early contentions over appointments, one discovers evidences of the rivalry

[1] Ann. Rept. of Sec. of N., 1842, p. 538, U. S. Statutes at Large, X, 196.

and jealousy that then existed between the staff and the line on the one hand, and naval officers and civilians on the other.

The terms of office of several of the early chiefs of naval bureaus were of unusual length. Rear-Admiral Joseph Smith, a fine officer of the Old Navy, who in 1846 succeeded Commodore Warrington as chief of the Bureau of Navy-Yards and Docks, held this position for almost a quarter of a century. John Lenthall, who in 1853 succeeded Samuel Hartt as chief of the Construction Bureau, served for more than seventeen years. He was the most eminent shipbuilder of the corps of naval constructors during the first years of the steam navy. Hartt, who was in office only a few months, was the first naval constructor to become head of the Construction Bureau. His predecessor, the last line officer to fill the position, was Commodore William B. Shubrick. Horatio Bridge was chief of the Bureau of Provisions and Clothing from 1854 to 1869; and William Whelan presided over the Medical Bureau from 1853 to 1865. Commodore Charles Morris was at the head of the Construction Bureau from 1844 to 1847; and at the head of the Ordnance Bureau from 1851 to 1856. In the latter place he succeeded Commodore Warrington, who had had charge of ordnance since 1846.

For a time the most important bureau was that of Navy-Yards and Docks and its head was the ranking officer among the bureau chiefs. In 1845 the control of the timber agents in the Southern States was assigned to this bureau; and in 1849 it was given charge of the Naval Asylum at Philadelphia, much to the displeasure of the Bureau of Medicine and Surgery, to whose care the asylum had been previously committed. The Bureaus of Construction, Equipment, and Repairs, and Ordnance and Hydrography were next in importance. Their work rapidly increased. To the former fell the building of the new steam fleet; and to the latter, the construction and improvement of naval ordnance and the direction of the educational and scientific establishments of the navy. The Hydrographical Office and the Naval Observatory founded in 1842, the Naval Academy founded in 1845, and the Nautical Almanac Office founded in 1849, were at first a part of the Secretary's office and their activities were immediately directed by the Secretary of the Navy; but in time they were all subordinated to the Bureau of Ordnance and Hydrography.

Under the act of August 31, 1842, the Navy Department was

allowed twenty-nine clerks. Secretary Henshaw regarded this force as inadequate, and in his annual report for 1843 he asked for nine additional clerks. To one of these, he wished to assign the custody of all the books and papers of the late navy commissioners and the library of the department. By 1860 the clerical force had increased to forty-two men. At this time the highest paid clerks were the chief clerk of the department, who received an annual salary of $2200, and the disbursing clerk, who received $2000. On the establishment of the bureaus in 1842, three clerks in the navy commissioners' office and one in the Secretary's office were made chief clerks of bureaus. The employees of the department were generally industrious, painstaking, and methodical in their work. In 1843, however, a subordinate clerk was discharged for gross negligence, inattention to duty, and "unpardonable inaccuracy."

The department continued to occupy the old Navy Department building, which was now well-worn and somewhat dilapidated. On the establishment of the naval bureaus, some of them found accommodations outside of this building. In 1851 several rooms in the "Winder building" were being rented. In 1844 the Naval Observatory and Hydrographical Office occupied their permanent quarters in Washington, which had been constructed under the superintendence of Lieutenant James M. Gilliss. Already the government was planning the construction of a new building for the joint occupancy of the Navy and War Departments.

Under the bureaus, the system of making purchases through navy agencies was continued. When navy-yards were located at Memphis and Mare Island navy agents for Memphis and San Francisco were appointed. Temporary navy agents or navy store-keepers residing at various naval depots supplied the needs of the squadrons in foreign waters. The ships of the home squadron when in the West Indies could obtain stores at St. Thomas, Aspinwall, or Key West. The Brazil squadron replenished its stores at Rio de Janeiro. The China squadron had depots at Manila, Singapore, Shanghai, Hong Kong, and Macao. The Pacific squadron obtained supplies at San Francisco and Monterey, California; Mazatlan, Mexico; the Sandwich Islands; Panama, New Grenada; Lima, Peru; and Valparaiso, Chile. For the African squadron depots were maintained at Porto Praya, Cape Verde Islands, and at Monrovia and St. Paul de Loando, on

the coast of Africa. Financial agencies were situated at London and Marseilles. At London the Baring Brothers had been acting as the agents of the department since about 1816. In 1846 Spain requested the removal of the American naval station from the island of Minorca, and the department acceded to the request. Mahon had become objectionable on account of the frequent disorders that occurred between the sailors of the American fleet and the soldiers and Mahonese rabble. Nor were the difficulties always confined to the sailors, for in 1842 Midshipman J. S. Anderson, when returning to his ship, was mortally stabbed through the heart. The department established the naval station for the Mediterranean squadron at Spezzia, Sardinia.

Grave charges of corruption and violations of law having been preferred against the Navy Department, the House in January, 1859, appointed a select committee to investigate the naval contracts and expenditures. The committee consisted of five members, three of whom were favorable to the administration, and two opposed to it. To the latter class belonged the committee's chairman, John Sherman, of Ohio. Many witnesses were examined and a voluminous report prepared containing about one thousand pages. The majority of the committee reported that some glaring abuses existed in the management of the New York navy-yard, and in the purchasing of anthracite coal, but that nothing had been proved impeaching the personal or official character of the Secretary of the Navy. The minority found Buchanan and Toucey guilty of corrupt practices and misdemeanors. The work of this committee was instrumental in bringing about reforms in the administration of the navy-yards.[8]

During the last months of Secretary Toucey's administration of the navy a state of incipient civil war existed. "The fact can not be disguised," President Buchanan wrote on January 8, 1861, "that we are in the midst of a great Revolution."[9] Under such circumstances he should have harked back to the memorable example set by one of the great founders of his party, Andrew Jackson, and have resolved to hold firmly and defend vigorously the public property of the United States. Instead, he adopted a weak and lukewarm policy of mild and innoxious defense, a policy of peace, conciliation, temporization, and avoidance of offense to the

[8] Sherman, Recollections, I, 158-161; House Rept., 35C. 2S., No. 184; House Rept., 36C. 1S., No. 621; Congress Letters XIII, 324.

[9] Richardson, Messages and Papers of the Presidents, V, 656-657.

South. Buchanan and his cabinet had their eyes set upon a compromise, and were continually smoothing the way to it. The failure of their passive plan was complete. The adherence of the Secretary of the Navy to it accounts for many of his acts that were denounced as traitorous by his Republican critics. His patriotism seems to have been sound.

The first indications in the Navy Department of the approach of the Civil War was the tendering by Southern officers of their resignations. From November 12, 1860, immediately after the election of Lincoln, until January 24, 1861, forty-seven naval officers from South Carolina, Florida, Georgia, Alabama, and Mississippi resigned. Toucey accepted each resignation as soon as tendered. In some instances this was of doubtful propriety. Those officers implicated in the surrender of the Pensacola navy-yard should have been first court-martialed, and only the innocent have been permitted to resign. Toucey might at least have hesitated to accept the resignation of an officer who declared that he wished to be released from his obligations to the United States in order that he might be free to act against the Union. Had the Secretary of the Navy showed deliberation, he would have been able to have strengthened his defense against the charges made in the following partisan resolution adopted by the House of Representatives on March 2, 1861: "Resolved, That the Secretary of the Navy, in accepting without delay or inquiry the resignations of officers of the Navy, who were in arms against the Government when tendering the same, and of those who sought to resign that they might be relieved from the restraint imposed upon them by their commissions on engaging in hostility to the constituted authorities of the nation, has committed a grave error, highly prejudicial to the discipline of the service and injurious to the honor and efficiency of the Navy; for which he deserves the censure of this House."

The charge that has been frequently made by high authorities that Toucey sent the naval ships abroad, or to inconvenient ports, in the interest of the South, is not true. He, however, administered the navy as if no war at home was threatening. He dispatched ships to the foreign squadrons in accordance with their needs. He failed to place the navy in a posture of defense. He made only the usual repairs of naval vessels, turning over to his successor a considerable part of the appropriation for repairs

for the fiscal year of 1860-1861. All this was a part of the policy of the administration. Without a change in it, Toucey could not have acted differently. According to it, the South must not be offended; and the prospects for a peaceful solution of the difficulties must not be jeopardized. Any movement of the North, offensive or defensive, it was feared, would touch off the fuse and precipitate a civil war, and this must be avoided at all hazards. Toucey was a victim of the policy of the administration.

On January 14, 1861, four days after Florida seceded, the Secretary of the Navy received the following telegraphic despatch, dated January 12, from Captain James Armstrong, the commandant of the Pensacola navy-yard: "Commissioners appointed by the Governor of Florida with a regiment of armed men at the gate demanded surrender of the navy-yard, having previously taken possession of one of our magazines. I surrendered the place and struck my flag at half past one o'clock this day." Rumors of this movement had been current at the yard for some time. On January 3, Toucey had telegraphed to Armstrong "to be vigilant to protect the public property." He had also ordered several vessels to Pensacola, and had ordered one from Pensacola. He had been very sparing of instructions to the commandant. Under all the circumstances his acts did not indicate any settled determination to defend the yard at all hazards. Armstrong struck his flag without making any defense. He was old, without initiative, and aware of the desire of the administration to avoid a rupture with the South. Some of his officers and many of his men sympathized with the seceding states, and were opposed to defensive movements. His failure to take measures to protect the public property and to oppose to the full extent of his ability the Florida troops deserved the strong condemnation which they received in the North.

The commissioners of Florida, on the surrender of the yard, placed it under the command of Victor M. Randolph, of Alabama. At this time his name was borne on the pay-rolls of the United States navy. He had been on leave of absence on account of ill health. On January 10 he forwarded his resignation to Washington. Before noon of January 12 he appeared at the head of the Florida troops before the gates of the Pensacola yard. His resignation was accepted by Toucey on January 14. It thus appears that Randolph was receiving pay from the United States

government at the time he was capturing its public property. Three officers of the yard next in rank to Armstrong, a commander and two lieutenants, soon after the surrender, resigned their commissions and took office under the new commandant. As a part of the policy of conciliation, the Secretary of the Navy on January 18 despatched Captain Samuel Barron to Pensacola, to patch up a truce between the Confederate forces at the navy-yard and the Unionists at Fort Pickens."

It is greatly to be regretted that Buchanan and Toucey did not vigorously defend the Pensacola yard. Neither the states-rights nor the nationalist theory of our government was directly at issue here. This yard had never belonged to the State of Florida, and under either theory she had no legal right to it. The feelings of the Northern naval officers on its surrender may be seen from the following words of Captain S. F. DuPont to Captain A. H. Foote, written on January 25, 1861: "But if I feel sore at these resignations, what should a decent man feel at the doings in the Pensacola Navy-Yard? Here I can not trust myself to speak; and the Department accepting these resignations, not waiting for a single particular after hearing that the Yard had been surrendered! . . . . Oh, why was not some one like you at Pensacola? I pass no judgment on the old commodore; he was in a tight place, and if he had only ironed well the traitors under him before he gave up, I should have been thankful." [11]

NAVAL SHIPS AND STATIONS.

Owing to the Mexican War, the annual naval expenditures during the fiscal years 1848 and 1849 increased to about $9,150,000, the highest since 1812-1815. This, however, was an increase of only $1,000,000 over the expenditures for 1842. The annual expenditures for 1844-1846 were about $6,300,000, considerably less than those for 1841-1843. This decrease marks a reaction against the policy of naval expansion of the Badger-Upshur administration. Secretary Bancroft, who entered the department in March, 1845, ardently furthered the counter-policy of

[10] House Rept., 36C. 2S., No. 87; Official Records, Ser. I, Vol. 14, 3-89; Congressional Globe, 1860-1861, pp. 1095-1097, 1423-1424; Sen. Rept. 37C. 2S., No. 37; Congress Letters, XIII, 340-347; Sands, From Reefer to Rear-Admiral 221; Naval Actions and History, 77-100; Chadwick, Causes of the Civil War, 248.

[11] Hoppin, Admiral Foote, 148.

naval retrenchment. For 1850, 1851, and 1852, the annual cost of the navy was about $7,750,000. In 1853 a period of increased naval expenditures set in, caused in large part by the acquisition of a steam fleet, the improvement of the navy-yards, and the augmenting of the number of naval officers. For the fiscal year 1859 the expenditures reached the wholly unprecedented sum of $14,233,000. Owing chiefly to the stringency of the national treasury, the cost of the navy in 1860 was some $3,000,000 less.[12]

As respects naval ships, the significant fact during the twenty years preceding the Civil War was the building of a steam fleet. The Old Navy was passing away. A period of transition in naval construction had set in. From 1843 to 1860 the number of sailing ships decreased from 59 to 44; while the number of steamships increased from 6 to 38. Of the 44 sailing ships remaining in the navy in 1860 not a few were old and of little value. The ships of the line were now used chiefly as receiving ships. Three of them were still upon the stocks. The Secretaries of the Navy, especially Secretaries Dobbin and Toucey, would have increased the steam fleet more rapidly than they did, but Congress repeatedly moderated their recommendations. As usual, the naval policy of Congress was adversely affected by perturbations and aberrations in the naval opinions of its members. The principal additions to the steam fleet were made during the six years, 1854-1859, when thirty steam vessels were added to the navy. From 1835 to 1853 only eighteen steam vessels were acquired. In December, 1859, Toucey said that the fleet had been increased by twenty steamships since his term of office began in March, 1857.[13] Of these, thirteen were built and seven purchased, at a total cost of a little less than $5,000,000. Twelve of the vessels constructed in 1857 and 1858 were steam sloops. They were fitted with screw-propellers, and at the outbreak of the Civil War were the best vessels in the navy of the smaller types.

In 1854 Congress appropriated $3,000,000 for the construction of six first-class steam frigates, to be provided with screw-propellers. These ships were built at the navy-yards on the Atlantic coast, and were launched in 1855 and 1856. They were the *Merrimac, Wabash, Minnesota, Roanoke, Colorado,* and *Niagara.* Their dimensions varied but little; those of the

[12] Sen. Ex. Doc., 45C. 1S., No. 3, 156.
[13] Ann. Rept. of Sec. of N., 1859, p. 1139.

Merrimac, whose name became historic, were, length 257 feet and beam 51 feet. Her displacement was 4636 tons. She cost $752,000. These vessels represented the most advanced type of construction in our navy before the Civil War. They were "objects of admiration and envy to the naval architects of Europe," who modeled some of their ships after them. Five of them were frigate-built, and one sloop-built. They were constructed of seasoned live oak. They were propelled chiefly by sails, having merely "auxiliary steam power." The engines were to be used chiefly in calms and in leaving port, and as aids in storms and in battle. At this time few naval experts foresaw that steam was destined to supplant entirely sails on board naval vessels.[14]

The earliest naval steamships, as might be expected, were only moderately successful. There was much experimenting with their boilers, paddle-wheels, smoke-stacks, and propellers. Some of the devices that were tried were more or less absurd. The *Missouri* was at one time fitted with lateral, instead of the usual perpendicular, smoke-stacks. The consumption of fuel on some of the first steamships was so great, according to the standards of the time, that they were placed out of commission to save expense. They were all fitted with sails, since their steam power was only an auxiliary means of propulsion. The *Fulton the Second* originally carried but 75 tons of coal, an amount sufficient for three days' steaming; her maximum speed was 13 knots. The *Mississippi* had a maximum speed of 9½ knots. She carried 620 tons of fuel, and had a complement of 260 men. Her horse-power was 498, and her tonnage 1693. Her armament consisted of two 10-inch and eight 8-inch shell guns. Her cost was $570,000. The first naval steamships were paddle-wheel vessels. In 1842-1843 the first screw-propeller war-ship was built. Its plans were furnished by the well-known mechanical genius, John Ericsson. The chief promoter of the enterprise was Captain R. F. Stockton, and the ship was named the *Princeton* after his home-town in New Jersey.[15]

In 1842 Congress authorized the Secretary of the Navy to contract with Robert L. Stevens, a distinguished American mechanic, for the construction of a war steamer, "shot and shell proof, to

[14] Bennett, Steam Navy, 141-153, app. B.
[15] Ex. Doc., 32C. 2S., No. 63.

be built principally of iron." This was the second ironclad ordered for the navy. The first was Robert Fulton's "bullet-proof boat," authorized in 1814; according to Fulton's plans, the boat was to be partly submerged, and its deck was to be plated with iron. After some delay Stevens laid down the keel of an ironclad, 250 feet long, 40 feet wide, and 28 feet deep. The plating was to be 4½ inches thick. In 1854 he abandoned his original plans and designed a much larger ship. The hull and machinery of the second vessel were practically completed when Stevens died in 1856. Work on the ironclad then ceased. In 1861 a naval board reported against completing the vessel, and the department's connection with it came to an end.[16]

In 1845 a "board of captains" was convened by the department to consider means of simplifying the naval ordnance. A uniform calibre throughout the fleet was now the ideal of naval officers in both this country and Europe. In 1829 this ideal had been in large part realized by France; and in 1839, by England. The board of captains, following the lead of these two countries, recommended the adoption of the long 32-pounder as the unit-calibre of the navy, and the use of only two kinds of cannon, the 32-pounder and the 8-inch shell gun. The department put in force the recommendations of the board. The simplification thus effected was, however, not so great as it may appear, for the 32-pounders were of six, and the 8-inch guns of two classes. Guns of larger calibres were shortly introduced into the navy. In 1854 the department adopted for the new steam frigates then building the Dahlgren 9-inch, 10-inch, and 11-inch guns; and by 1856 several of the larger ships were mounting 64-pounders. At the outbreak of the Civil War cannon of various sizes and kinds were in use.[17]

The Mexican War did not cause a large increase in the number of naval ships. During the war some 20 small craft were temporarily added to the navy. In 1846 the United States came into possession of the Texan navy. By the terms of annexation, Texas ceded to the Union her navy, navy-yards, and docks. On May 11, 1846, Hiram G. Runnels, acting as the agent of the federal government, received from the Texan authorities the sloop *Austin*, the brigs *Wharton* and *Archer*, and the schooner *San Bernard*. The *Austin* was sent to Pensacola to be rebuilt. The remaining vessels, since they were not worth repairing, were sold.

[16] Bennett, Steam Navy, 262; Thurston, Robert Fulton, 153.
[17] Dahlgren, Shells and Shell-Guns, 14, 23, 259-292.

The period of 1842-1861 was an exceedingly important one in the history of the navy-yards. Two new yards were established, one at Mare Island and the other at Vicksburg. In 1848 the area of the New York yard was increased. The Mexican War revealed the need of a first-class establishment at Pensacola, and during the war liberal appropriations for this yard were made for the first time. By 1861 it was in comparatively good condition. The disposition of Congress to give the South a larger share of the naval appropriations was of advantage to the Pensacola establishment. By the outbreak of the Civil War the navy-yards had taken on a somewhat modern appearance. New machinery adapted to the building and repair of steamships had been installed and various boiler shops, coal sheds, and other improvements had been constructed. The annual appropriation for the improvement and repair of the navy-yards increased from about $500,000 for 1842, to more than $2,100,000 for the fiscal year 1858, and to almost $1,600,000 for the fiscal year 1859.[18] In the latter year Congress changed its policy respecting the yards, and for two years appropriated nothing for their improvement. At the beginning of the Civil War the principal establishments were those at Boston, New York, Norfolk, Pensacola, and Mare Island; and the secondary or auxiliary ones, those at Portsmouth, Philadelphia, and Washington.

The need of a naval depot and rendezvous on the West coast was early recognized. In 1838 Secretary Paulding ordered the commander of the Pacific squadron to make a close and accurate survey of the straits of Juan de Fuca in order to ascertain their fitness for a rendezvous of the American navy in the Pacific. Paulding also ordered Lieutenant Charles Wilkes, partly with a view to the interests of the navy, to devote as much time as the objects of the United States Exploring Expedition would permit to an examination of the Columbia River, the coast between it and California, and most especially the Bay of San Francisco, "represented as one of the finest in the world." In 1841 Secretary Upshur recommended the establishment of a naval depot and rendezvous on the West coast. The settlement of the differences with Great Britain over Oregon, the acquisition of California and New Mexico, and the discovery of gold in California greatly enhanced the importance of the Pacific squadron and its need of

[18] U. S. Statutes at Large V, 500-501, XI, 244-245, 316.

a naval station. In 1847 a station was established at Monterey, California. In 1848 a joint board of army and navy officers was organized and sent to the Pacific coast to report on the location of fortifications, lighthouses, navy-yards, and dry docks. The principal naval officer on the board was Commander Louis M. Goldsborough. Secretary Mason in his annual report for 1848 recommended the establishment of a navy-yard and dry dock on the coast of California; and the next year Secretary Graham made a similar recommendation.

In September, 1850, Congress authorized the Secretary of the Navy to enter into a contract for the construction of a sectional or a floating dock and a basin and railway at such harbor on the Pacific coast as he might select. Graham at once contracted with Eastern builders to construct a sectional dock for $610,000. The contractors were permitted to prepare their materials on the Atlantic coast. The permanent location of the dock could not, however, be fixed until the site for a navy-yard was determined. The central situation and excellent harbor of San Francisco bay permitted no question as to the general location of the yard. Its exact situation on the bay or its connecting waters was a matter of some difference of opinion. In 1852, in accordance with an authorization of Congress, the Secretary of the Navy appointed a board to choose a site. It selected Mare Island, which is situated some 30 miles northward of San Francisco, in the extensive sheet of waters connecting with San Francisco bay. The Mexican name of the island was *Isla de las Yeguas.*

In August, 1852, Congress appropriated $100,000 to buy Mare Island, to make surveys, and to begin improvements. The island was purchased on January 4, 1853, for $83,491. It contained 1066 acres. In making the transfer, certain difficulties arose in respect to the title. These were not removed until July, 1854. The first commandant of the yard was Commander David G. Farragut, who was appointed to this position in August, 1854. To Farragut fell the responsible duties of planning and building up the yard, under the general instructions of the department. When he arrived at the island, there were no improvements on it. He and his family were compelled to spend the first seven months on an old sloop of war anchored near by. The yard was rapidly improved during the four years that Farragut was commandant. A wharf, shops and sheds of various kinds, and dwelling houses for the officers, were

erected. The grounds were graded and the streets paved. The sectional dock and the basin and railway were completed and were placed in position."

The most important improvements made under the Bureau of Navy-Yards and Docks during 1842-1861 were the construction of several dry docks for the repairing of vessels. Mention has already been made of the floating sectional dock built for the Mare Island navy-yard. The construction of a dry dock for the New York yard was long delayed. In 1835, Congress appropriated $100,000 for this purpose, but owing to a disagreement over the location of the dock little of the money was expended. Finally the work of construction was begun on October 1, 1841; but on August 1, 1842, it was discontinued, after the expenditure of $35,000. It was resumed on April 1, 1845. These delays were caused chiefly by the questions that arose respecting the removal of the New York yard, and by doubts as to the proper materials of construction for the proposed improvement. In the end it was decided not to move the yard, and to build the dry dock of stone. The work was placed under the direction of W. P. S. Sanger, the civil engineer of the Bureau of Navy-Yards and Docks. The most serious obstacles which Sanger encountered were caused by numerous springs of water. So strong was the pressure from these springs, that vent had to be given them through the bottom of the completed structure. By January, 1850, the work had advanced far enough towards completion to admit of the docking of the U. S. ship *Dale*. On September 1, 1851, the dock was turned over to the commandant of the yard. Its total cost was $2,146,255. It was somewhat larger than the similar structures at Boston and Norfolk. The main chamber at the top was 307 feet long and 98 feet wide.

In 1847 Congress ordered the construction of a floating dry dock at each of the navy-yards at Portsmouth, Philadelphia, and Pensacola. At this time a floating dry dock was not so durable nor so well adapted to the docking of large ships as those constructed of stone, but it was much cheaper to build. In August, 1848, Congress, guided by the report of a board of officers, and by a report of the Bureau of Navy-Yards and Docks, specified with more detail the character of these three improvements. That

[19] Congress Letters, VII, 513, Ann. Rept. of Sec. of N. 1841 p. 369; 1848, p. 619; 1849, p. 436; 1851, p. 8; Bay of San Francisco, 325; Miscl. Data, Bureau of Yards and Docks 8; Mahan, Admiral Farragut, 99.

at Portsmouth was to be a "floating dry dock"; that at Philadelphia, a "sectional floating dry dock"; and that at Pensacola, a "balance floating dry dock." Work upon them was at once begun by the contractors. In 1852 the Portsmouth and Philadelphia docks were accepted. A test of the Pensacola dock made in 1853 was not satisfactory, and it was not accepted until 1855. A notion of the size of these structures may be gained from the dimensions of the Portsmouth dock; it was 350 feet long and 105 feet broad.[20]

The specializing of the Washington yard in the manufacture of ordnance may be dated with the appointment of Lieutenant John A. Dahlgren as ordnance officer. Here in 1847 Dahlgren began his great work of improving the naval ordnance. In 1848 his department at the yard was placed under the direct charge of the Navy Department. During this year he established an experimental battery, with ranges, on the Eastern branch of the Potomac. In 1850 he submitted to the Secretary of the Navy plans for a "Naval Ordnance Establishment," but they were not approved. He of course expected to be made superintendent of the new department. Like his friend, Lieutenant M. F. Maury of the Naval Observatory, he was an ambitious genius and a steady promoter of his own interests. He was the first ordnance expert to design cannon proportioned to the "curve of pressures." His most important invention was the "Dahlgren gun." The first Dahlgren was a 9-inch shell gun, and weighed 9000 pounds. Later he made 10-inch and 11-inch guns, some of which could throw shells weighing 170 pounds. He improved several kinds of small ordnance, and invented a navy howitzer that was much used. In 1859 he began the manufacture of rifled cannon. Dahlgren was a man of conspicuous ability and indefatigable energy, and took high rank among the ordnance experts of his time.[21]

NAVAL OFFICERS AND SEAMEN.

The work of the navy from 1842 to 1861 was similar to that under the navy commissioners. The fleet was chiefly engaged in the protection of American commerce and citizens in foreign ports and waters, the suppression of the slave trade, and the making of scientific explorations and surveys. It was regularly organized into six squadrons: the African, Mediterranean, Brazil,

[20] Ann. Rept. of Sec. of N., 1845, p. 666; 1851, pp. 168-169; Hamersly, Naval Encyclopedia, 218; U. S. Statutes at Large, IX, 170-171, 270-271.

[21] Dahlgren, Dahlgren, 125-235.

Pacific, East Indian, and "home" squadrons. The cruising-grounds of the home squadron included the West Indies; and of the East India squadron, the China seas. Although the Mexican War was fought chiefly by the army, the navy nevertheless rendered some important services. It blockaded and occupied several Mexican ports, co-operated with the army in the capture of Vera Cruz, and seized and conquered the coast of California. Of the officers who took part in the war, Commodores Conner and Perry most distinguished themselves in Mexico; and Commodores Sloat and Stockton, in California. In 1847 Perry commanded the largest fleet, with possibly one exception, that up to this time had been assembled under the American flag.

Questions relating to the naval personnel now pressed for solution even more insistently than under the navy commissioners. These had to do chiefly with the education and improvement of officers and seamen, naval rank, a retired list for officers, and the government and discipline of the navy. All these questions received much attention from Congress and the Navy Department. Several noteworthy laws relating to them were passed, and they were made the subjects of not a few important departmental regulations.

During the first two decades under the naval bureaus reasonably adequate educational facilities for young line officers were established. From 1842 to 1845 the agitation in Congress for a naval academy was continued, but without success. The problem of naval education was at last solved by the Secretaries of the Navy without recourse to federal legislation. A long step towards its solution was taken by Secretary Bancroft in 1845 when he moved the Naval School at Philadelphia to Annapolis to a home-plot of its own, reorganized and enlarged it, and greatly improved its curriculum. A step of almost equal importance was taken in 1850-1851 when the school was named the "Naval Academy," was again reorganized, and a four years' course of study was adopted. During the decade preceding the Civil War, the Naval Academy grew steadily in numbers, educational facilities, and efficiency of instruction.

These improvements in naval education elevated the character of the naval officer and the moral tone of the service, and doubtless had their influence in bringing about a decline of dueling. Moreover, public sentiment both in and out of the navy was now

setting strongly against this lamentable practice. The naval regulations prepared by a board of naval officers in 1857 made dueling punishable by dismissal from the navy or by such other penalty as a court-martial might inflict. As early as 1839, Congress, moved by the sentiment aroused by the unfortunate meeting between Congressmen Cilley and Graves in 1838, passed a law forbidding the giving or accepting of a challenge in the District of Columbia. The act for the better government of the navy of July 17, 1862, made the sending or accepting of a challenge, or the acting as a second, subject to such punishment as a court-martial might adjudge; and the naval regulations of 1865 contained this provision on the subject: "No person in the Navy will upbraid another person in the Navy for refusing a challenge to fight a duel. Every person is enjoined to assist in the honorable adjustment of any differences that may occur. No disgrace can attach to any one for refusing a challenge, as such a course would be in obedience to law." It is probable that a few duels among naval officers were fought during the Civil War, and at least one since that conflict.[28]

Under the naval bureaus the principle of testing the fitness of officers for appointment and promotion by means of examining boards received new applications. Admittance to the engineer corps was conditioned on the passing of a technical examination. In August, 1846, Secretary Bancroft issued a general order establishing an entrance examination for naval constructors, boatswains, gunners, carpenters, and sail-makers. He recommended that the fitness for promotion of all line officers should be determined either by examining boards or by the reports of commanders on the efficiency of their subordinates. He held strong views on this subject, declaring that the "doctrine that advancement is due to seniority alone, irrespective of capacity for duty, places personal interests before the public good and partakes of the very essence of the worst form of an aristocracy."[29]

In 1844, Congress, taking from the President a power which he had long exercised, fixed by statute the number of seamen in the navy. From 1844 to 1857, with the exception of the years of the Mexican War, the number of seamen thus established was 7500. In the latter year it was increased to 8500. During the Mexican

[28] U. S. Statutes at Large, V. 318, XII, 602; Ann. Rept. of Sec. of N., 1858, p. 234; Regulations of the Navy, 1865, p. 30.

[29] Navy Register 1859, pp. 131-132; Ex. Doc., 29C. 1S., No. 188, 7.

War Congress authorized a naval force of 10,000 men, and the addition of 1112 officers and men to the marine corps. Only about 8100 men, however, were enlisted in the navy. In 1854 the marine corps, all told, numbered only 1452 men. It had grown very little in the past fifty years.[24]

The apprentice system of 1837 lasted until 1843. In 1855 Secretary Dobbin put into operation a new system, and enlisted 500 boys between 14 and 18 years of age with a view to training them for a seafaring life. Dobbin also recommended the teaching of seamen the "management of heavy ordnance in storm and calm" on board an ordnance-ship. Accordingly, in 1857 the ordnance-ship *Plymouth*, under Commander John A. Dahlgren, went to sea for a six months' cruise. This was one of the first practice cruises of our navy for the instruction of seamen in gunnery. The apprentice system of 1855, like that of 1837, was soon abandoned.[25]

The crews of the ships of the Old Navy were divided into five classes; petty officers, seamen, ordinary seamen, landsmen, and boys. According to law, their pay was fixed by the President. In 1830 the petty officers received $18 a month; seamen $12; ordinary seamen $10; landsmen $8; and boys, $8 or $5. The petty officers were selected by the captain from the most experienced and trustworthy of the seamen. On board a frigate, they consisted of a master-at-arms, eight quarter-masters, four boatswain's mates, eight quarter-gunners, a boatswain's yeoman, gunner's yeoman, carpenter, sailmaker's mate, armorer, cooper, cook, and coxswain. The seamen had much pride of profession and entertained the greatest contempt for men who knew nothing of the seafaring life. The landsmen were as "green as a cucumber, having never smelt salt water." The boys were principally employed as servants to the commissioned officers. The crews were usually shipped for three years, at the end of which time they were discharged. In 1852 President Pierce and Secretary Kennedy recommended the establishment of a permanent corps of seamen.[26]

A too long and exclusive use of salty meats, hard bread, and bad drinking-water often caused scurvy, the scourge of the sailor of the olden time. Small-pox and in tropical latitudes cholera and yellow fever were not uncommon. In dealing with these and

[24] U. S. Statutes at Large, V, 699, IX, 100, 154-155; Ann. Rept. of Sec of N., 1847, p. 945; 1850, p. 200; 1854, pp. 584-585.

[25] Ann. Rept. of Sec. of N., 1856, p. 411; 1857, p. 579.

[26] Wines, Two Years and a Half in the Navy, I, 38-41.

other diseases the early naval surgeons were less skilful and successful than those of the present day, since in the first half of the last century modern medical and surgical science was in its infancy. On some of the old ships the ventilation was bad beyond belief. They were so overcrowded that the "men lived almost like kenneled dogs." The excellent and abundant air aloft and on deck had to compensate for its foulness in the sleeping apartments. The berths on the berth-deck of the *Constellation* were 18 inches in width by 9 feet in length, and were practically without ventilation. The living space on shipboard has been greatly increased in recent years. While a modern battleship is more than five times the size of an old 44-gun frigate, it carries practically the same number of men. The ships of the Old Navy were models of order and cleanliness, and careful captains were generally able to keep their crews reasonably healthy.[27]

The man-of-war's men of the olden time were interesting and picturesque characters, possessing many good and bad qualities strangely intermingled. An ancient schoolmaster of our navy wrote that "generosity, a sort of grumbling contentment, susceptibility to kindness, a mixture of credulity and scepticism, a superstitious dread of imaginary and a contempt of real dangers, a strong love of the marvellous, a rough open-hearted simplicity of manners and language, gross sensuality, shocking profaneness, imperturbable effrontery in lying, and an insatiable thirst for strong drink, will generally be found to be the constituent parts of a sailor's character when carefully analyzed. On the whole, the bad qualities preponderate, and the character of our seamen as a body is very low in the scale of moral excellence."[28]

Some notion of the temptations and impositions to which the sailors were subjected may be obtained from the following extract taken from the autobiography of Samuel F. Holbrook, a petty officer of the navy. His vessel, the sloop-of-war *Ontario,* arrived at New York on May 27, 1817, after a cruise in the Mediterranean:

"Scarcely had our anchor gone from the bow, before the ship was surrounded by land sharks and bad women; the latter, however, were not permitted to come on board; and only a few of the former. They obtained permission only by urgently desiring to

[27] Hollis, The Frigate Constitution, 18-19.
[28] Wines, Two Years and a Half in the Navy, II, 112.

see some particular friend. As none of the crew were allowed to go on shore, the landlords went off, but soon returned with any quantity of good things, such as pies, puddings, roast beef, chickens, and had also contrived to smuggle on board an ample supply of good stuff to wash down the savory viands; notwithstanding they were strictly forbidden against bringing any intoxicating liquor on board, the master-at-arms was placed in the gangway with the orders to search everything and everybody, and 'the Maine Liquor law in full force,' there were bottles of brandy, gin, rum, and wine enough to supply a regular bacchanalian feast. Tailors and watch venders came alongside; and all, knowing that the boys had between $300 and $400 a piece coming to them, were very willing to trust them to any amount. Nothing pleases this sort of sailors so much, as to show a willingness to trust them; and what was very remarkable, nearly every one of these skulking lubbers that had been in the sick bay during all the bad weather and were so sick that they could not be turned over in their hammocks without a crowbar, were the most lively and vociferous among the whole crew; and with the rest were all blind drunk before morning. Many of these fellows had bought nice long-tailed coats, pantaloons, new hats, watches, and dandy boots, and everything to constitute a fine go-ashore-rig; for which, as it subsequently appeared, they were charged $100, and some of them put on their new rig to see how they would look. One fellow would try to haul a pair of dandy pantaloons over a thick pair of blanket drawers and a great brawny leg, which would tear them of course; and then off they go, and he must have another pair, which with considerable trouble and with the assistance of the tailor he managed to get on; then his legs looked like well-stuffed sausages. Another would try to get a narrow-backed coat over a pair of broad shoulders, when, away goes the back, and another $20 out of the fool's pocket, and in this way these land pirates contrived to rob this crew." [39]

On board the larger ships the spiritual and moral welfare of the sailors was doubtless improved by the ministrations of the naval chaplains, who were generally, although not invariably, men of piety and high character. Even this slight boon was denied to the crews of the smaller vessels, to which no chaplains were assigned. At the principal navy-yards Sunday-schools were estab-

[39] Holbrook, Autobiography, 190.

lished for the enlisted men; and numerous bibles, testaments, prayer-books, and religious tracts were distributed for their edification. A pious visitor to a Sunday-school held on board a man-of-war at the New York yard describes it as being "particularly solemn. Nearly 200 naval boys were present, and some of the officers, while many of the old tars leaned upon the heavy cannon, in serious attention to the religious services. The band aided in the sacred melodies; and the whole service was truly impressive. Nearby was moored the *Somers,* bringing forcibly to mind the awful consequences of sin among her crew; and below in irons were some of the actors in that terrible mutiny."[20] To another visitor the occasion of a religious exercise appeared less solemn, for he records that the old tars grew painfully restive as the time for the distribution of their grog approached and the service showed no signs of being brought to a close.

Beginning about the middle of the first half of the nineteenth century, a strong humanitarian sentiment arose in the North, and especially in New England. Many devout and kind-hearted men and women of this section manifested a warm sympathy for the slaves of the South, the American sailors, and the suffering and downtrodden of all lands. Before 1840 boarding-houses, schools, reading-rooms, savings-banks, and churches had been established for the seamen. In that year, with a view to enlightening the public as to the hardships of the merchant service, Richard H. Dana wrote his "Two Years Before the Mast," one of the world's classics of adventure. The zeal of some of the reformers often outran their knowledge of actual conditions. Their activities in behalf of man-of-war's men, while partly encouraged by the navy, was sometimes resented as an unwarranted interference. There can be no doubt, however, that ample room for improvement existed.

Two time-honored practices of the Old Navy were flogging and the issuing of grog. They had been long common in every navy of Christendom. Flogging was first established in our service by the Continental Congress in 1775. The act for the bettering government of the navy, passed on April 23, 1800, limited the number of lashes that might be inflicted by a captain to 12; and by a court-martial, to 100. An act of the previous year made the cat-o'-nine-tails the legal instrument of punishment, and per-

[20] Army and Navy Chronicle, 1843, p. 278.

mitted the use of "no other cat." The boys of the navy, however, were often punished with a smaller whip called the "boys' cat," or "kitten." In practice a lieutenant was allowed to give a dozen lashes with the "colt," a rope with a knot in the end of it. Rear-Admiral Foote says that when he was mate of the gun-deck of a frigate he always carried a colt in his cap ready for use. Rear-Admiral Thatcher, when first-lieutenant, kept one under his pillow for the disciplining of the ward-room boys. Among the common offenses punishable by means of the cat-o'-nine-tails were drunkenness, fighting, skulking, theft, cursing, disobedience of orders, sleeping on the lookout, and smuggling of liquor. The cat consisted of nine small hard-twisted pieces of cotton or flax cord, with three knots in each, fixed on a short thick rope as a handle. The lashes were administered on the bare back of the culprit, in the presence of his comrades, at the gangway of the ship. The cat was wielded by the boatswain's mate, whom the seamen regarded as a devil incarnate. The master-at-arms counted audibly the blows. In exceptional cases the cat was applied with horrible brutality. Captain Wolcott Chauncey once flogged two young men until the "flesh was fairly hanging in strips upon both backs; it was a sickening sight." Chaplain C. S. Stewart, writing in 1829, says that the "keenest emotions that I have known on board the *Gurriere* have come suddenly upon me in the sound of the lash and the cry of some wretch suffering at my side." He felt that there was an indignity and degradation in this mode of punishment.[21] The sailors, however, looked at flogging quite differently.

An interesting, though melancholy, anecdote was once told by Commodore J. H. Aulick in proof of his belief that "badges of disgrace" could not be effectively employed as substitutes for corporal punishment: "On my passage to the Mediterranean some 30 years ago, an old seaman was brought to the gangway, by order of the Captain, for some offence he had committed; when the Captain said to him, 'You are only an old woman unworthy of being punished as a man.' And he ordered the boatswain's mate to dress him in tarpaulins to represent a woman. The old man protested that he was a man, and was ready to receive the punishment of a man. 'Give me,' said he, 'my dozen, or as many lashes as you think proper, but I will not submit to being

[21] Holbrook, Autobiography, 98.

disgraced. I'll jump overboard rather than submit to it.' The dressing was completed. The man went forward, and immediately threw himself under the bows of the ship. We were sailing at a rapid rate, and though every effort was made to save him, he sank to rise no more." [22]

To the sailor of the Old Navy a much severer punishment than flogging was the "stopping of the grog." Both in the Continental navy and the early navy under the Constitution the regular daily allowance of spirits to each man was half a pint. In 1842 this was reduced to one-fourth of a pint, or a gill. The marines were given a half-pint of distilled spirits or one quart of beer daily. On Christmas the allowance was doubled. Until the administration of Secretary of the Navy Robert Smith rum was the spirits issued. Smith introduced the use of whiskey which in time became common. Efforts were made to substitute wine and beer for spirits, but they failed. The sailors refused to drink these mild beverages. The cargo of whiskey, which on a 44-gun frigate amounted to 100 barrels, was the largest single item of expense for the stores of a ship. Secretary of the Navy Woodbury, 1831-1834, who favored the gradual abolition of the spirit ration, promulgated an order permitting the sailors to commute their grog for money; and in 1842 a law was passed forbidding the issuing of spirits to all minors, whether officers or seamen. Some of the chaplains and naval surgeons were early advocates of temperance in the navy.

By 1845-1850 the feeling in the North in favor of the abolition of flogging and the grog had come to be exceedingly strong. In 1849 the legislature of Rhode Island adopted a resolution requesting the senators and representatives of that State in Congress "to use their best influence to have the supply of ardent spirits as rations, and the use of the lash, prohibited throughout our navy." Many memorials on these two subjects were sent to Congress. In 1845 the Naval Committee of the House recommended the abolition of the grog; and in 1849 the House voted to prohibit flogging. The deep interest manifested in these subjects led Secretary Preston in January, 1850, to address a circular letter to the leading officers of the navy asking for their views upon the abolition of corporal punishment and the spirit ration. Their replies reveal that the navy was almost a unit against doing

[22] Letters of Officers on the Abolition of Flogging, No. 22.

away with the cat, and that a strong sentiment existed in favor of gratifying the sailors in their love of the grog. Even the sailors were generally opposed to the abolition of flogging, and some of them petitioned Congress to leave them this manly form of punishment. In 1850, in direct opposition to the preponderance of opinion in the navy, Congress abolished flogging. A provision to this effect passed the House by a large majority, but it narrowly escaped defeat in the Senate. The fight in the latter body was led by John P. Hale, of New Hampshire.[33]

Immediately after the disuse of the cat numerous complaints reached the Navy Department of insubordination and serious irregularities among the seamen. Some 200 or 300 men left the frigate *Brandywine* in willful violation of orders. The number of desertions increased, and many good seamen refused to enlist. In June, 1851, the department addressed another circular letter to the leading officers of the navy asking for their views on the effect of the recent law. The consensus of naval opinion was that the effect was very bad. Frequent complaints against the disuse of the cat were made by the seamen. In 1852 the demoralization of the navy continued, and the officers still had hopes that Congress would reconsider its decision. The evils caused by the prohibition of flogging were greatly increased by the failure of Congress to establish new punishments to take the place of the old one. The Secretaries of the Navy for several years recommended the revision of the penal code of the navy in order to adapt it to the new conditions. Finally, Congress acceded to their wishes, and in 1855 established summary courts-martial. These courts could be ordered by the commanders of vessels, and they could inflict various minor punishments, such as dishonorable discharge from the service, "solitary confinement in irons, on bread and water or diminished rations," reduction in rating, deprivation of liberty on shore, extra police duties, and loss of pay. After their establishment, naval discipline was completely restored.[34]

The abolition of the spirit ration was delayed until 1861 and

[33] Ex. Doc., 23C. 1S., No. 486; U. S. Statutes at Large, V, 547; Sen. Miscl. Doc., 30C. 2S., No 63; Letters of Officers on the Abolition of Flogging; Congressional Globe, 1848-1849, p. 506; 1849-1850, p. 2057.

[34] Sen. Ex. Doc., 31C. 2S., No. 12; Sen. Ex. Doc., 32C. 1S., No. 10; Ann. Rept. of Sec. of N., 1850, p. 207; 1852, p. 312; 1853, p. 315; 1854, p. 394; U. S. Statutes at Large, X, 627.

1862. In the former year Congress forbade it to commissioned and warrant officers, and in the latter year it was enacted that the "spirit ration in the navy of the United States shall forever cease." Next to spirits, the chief articles of diet of the sailors of the Old Navy were bread, beef, pork, and beans. On certain days of each week, peas, cheese, rice, suet, butter, vinegar, and molasses were served. The quantities of these articles allowed are enumerated in the navy ration established by Congress in 1801. In 1842 a few luxuries were added—dried fruits, tea, coffee, sugar, cocoa, pickles, and cranberries. At sea the main reliance of the sailors was "salt junk and hard tack," that is, salted provisions and sea-biscuit. In port, for this fare, "fresh grub and soft tack," the sea-terms for fresh meats and bread, were substituted. The staple desert of the sailors was "duff," a heavy indigestible plum pudding. "Lobscowse," a hash consisting of salt beef and potatoes, was a favorite dish. The bread was often moldy, and the drinking-water offensive to the smell as well as to the taste. For convenience in serving the food the crew was divided into messes of 15 to 20 men each. Each member of a mess took turns in waiting on the table, receiving the title of "berth-deck cook." Sometimes a boy was given this duty. Although his fare was simple and monotonous and not always well-cooked, yet Jack ate it with an abundant appetite, highly sharpened by physical exercise and an out-of-door life. We are told that "princes do not sit down at their tables, groaning beneath a thousand delicacies, with greater contentment, or enjoy their luxurious viands with a higher relish, than those which the tempest-tost, weather-beaten sailor squats by the side of his greasy tarpaulin, and devours his humble dish of lobscowse or duff."[35]

The questions of naval rank that for a long time agitated the navy related to either "relative," "higher," or "assimilated" rank. The relative rank of army and navy officers was agreed upon in 1850 by a board composed of officers drawn from the two services. The report of the board was approved by the Navy Department. Congress, however, failed to act upon it, although its attention was directed to the subject by President Pierce in his annual message for 1851.[36]

The movement for higher ranks in the navy during the 20

[35] U. S. Statutes at Large, II, 110; V. 546; XII, 265, 565; Wines, Two Years and a Half in the Navy, I, 16-51.

[36] Richardson, Messages and Papers of the Presidents, V, 88.

years preceding the Civil War was well-nigh fruitless. Nothing less than a successful war with its train of naval heroes and its need of commodores and admirals to command its fleets in battle would obtain for the navy this boon. In 1857 Congress passed a law giving the commander of a squadron the designation of "flag-officer," a very awkward term. About this time the department directed that a captain of 20 years' standing when in command of a squadron should carry at the fore a square flag—the designation of a vice-admiral; and that a captain of less than 20 years' standing should carry at the mizzen a square flag—the designation of a rear-admiral. Captain W. B. Shubrick, who assembled a fleet at the mouth of the La Plata in 1858, was the first American officer to carry abroad a vice-admiral's flag. A short time previous, Captain E. A. F. La Valette for the first time in the American navy displayed the flag of a rear-admiral. A joint resolution of Congress of March 2, 1859, conferred on Captain Charles Stewart, in recognition of his distinguished and meritorious service, the rank of "senior flag officer of the United States navy on the active service list."[87]

The warm contentions between the line and the staff officers over assimilated rank caused much bitterness and jealousy on both sides. The "line" may be defined as those officers whose essential duty is to fight the enemy, and who have naval command. The line grades were those of captain, commander, lieutenant, master, and midshipman. The "staff" comprises those officers whose duties are auxiliary to the line, and who do not have naval command. The staff officers were the surgeons, pursers, engineers, chaplains, and professors of mathematics. Assimilated rank may be defined as the relative position of the staff officers to those of the line. In 1842 the staff did not have assimilated rank, but ardently desired it.

The civilian may have some difficulty in understanding the character and importance of assimilated rank. To the naval man the nature of this incorporeal hereditament is very clear and real. In naval and official life, and especially in the society aboard ship, rank confers precedence, social rights and privileges, and the esteem of your fellows. It determines the apartment in which an officer sleeps, the position of his chair at the table when eating,

[87] Cooper, Navy of United States, 1866, III, 108; U. S. Statutes at Large, XI, 442.

his relative position on entering or leaving the ship, his place of promenade on deck, and the fashion and decorations of his clothes. The official worth of a man on board ship is read by his fellow-officers from the buttons and gold bullion on his coat, and he is esteemed accordingly. To be without rank is to be penniless of the current coin of the naval realm. An officer with rank may demand privileges as his right; while without rank he may accept them, if offered, as a courtesy. If the staff officer in the days before he was granted assimilated rank was fortunate in his shipmates, he might have no cause to complain; but if not, he would "break the bread of bitterness to the end of the cruise."

The surgeons were foremost in presenting their case and urging their claims. The pursers were scarcely less insistent; and soon the engineers had increased in numbers and began to make demands. The line naturally resisted the assignment of rank to the staff. An institution that has developed traditions and a corporate life, and that enjoys a monopoly of rights and privileges, is wont to resist strenuously its being cheapened or made common either by undue additions to its membership or by extension of its privileges to others. The line argued with reason that rank, owing to its very essence, belonged peculiarly to the "military corps" of the navy, and that it was incongruous to clothe the staff in the garb of the line. It urged that the granting of rank to the staff would injuriously affect the discipline, harmony, and general good of the service; that the wearing of epaulets by both classes of officers would cause confusion; and that to admit staff officers to seats on courts-martial was not "military." A respectable lieutenant of this period is reported to have said: "I hold my rank dearer than life itself, and were any purser of the navy to sign an official report above me, I would cleave him to the chin with my cutlass. I could never suffer my rank to be outraged in that way; I would rather die."

In the end, the movement for assimilated rank proved to be too strong for the officers of the line; nor, indeed, did all of them oppose it. Secretaries Upshur, Henshaw, and Mason, each in turn, favored the claims of the staff. Finally, Secretary Bancroft solved the problem so far as the surgeons were concerned by issuing the general order of August 31, 1846, according to which, surgeons of the fleet and surgeons of more than 12 years standing were to rank with commanders; surgeons of less than 12 years

standing, with lieutenants; passed assistant surgeons, next after lieutenants; and assistant surgeons, next after masters. A similar order of Secretary Mason, issued in May, 1847, fixed the assimilated rank of the pursers. These orders were thoroughly disliked by the line, and many officers considered them illegal. Each side published pamphlets setting forth its own arguments. In 1848, 60 or 70 officers of the line met in Washington to concert action with a view to obtaining a revocation of the orders of Bancroft and Mason. The current, however, could not be turned. In 1854 Congress gave these orders the sanction of law. The engineers had a long struggle before they won the coveted prize. In January, 1859, they were granted assimilated rank by a general order of Secretary Toucey; and a little later in the same year Congress inserted the order in the naval appropriations act.[28]

Upon the construction of many new steamships during the decade preceding the Civil War, the engineer corps greatly increased in numbers and importance. In 1860 it contained 175 engineers. A most significant recommendation in respect to the engineers was made in 1854 by the board of visitors to the Naval Academy, and was repeated by the board for 1859: "In view of the great and growing importance of the steam engine as applied to ships of war, the board have given very mature consideration to this subject, and are satisfied that the union of the duties of the engineer with those of the sea officer, so far from being incompatible, will be found entirely practicable and of decided advantage. The watches may be so arranged as to give to each officer who leaves the academy his regular turn of duty at the engine and on deck, and thus an intimate knowledge of the duties of the engineer and sea officer may be kept up at the same time."[29] More than 40 years elapsed before this recommendation was realized in the amalgamation of the line and the engineers by the Naval Personnel Act of 1899.

On February 28, 1855, Congress passed "an Act to promote the Efficiency of the Navy." The enforcement of no other naval law has probably caused so much discussion, commotion, and ill-feeling. For some 15 years presidents, secretaries of the navy, naval officers, civilians, and newspapers had advocated the estab-

[28] Ruschenberger, Controversy on Assimilated Rank; Navy Register, 1849, p. 44; U. S. Statutes at Large, X, 587; XI, 407.

[29] Ann. Rept. of Sec. of N., 1859, p. 1161.

lishment of a retired or reserved list of naval officers. Many of the annual reports of the secretaries of the navy between 1842 and 1854 treat the subject at considerable length. Bills providing for a retired list were from time to time introduced in Congress. For various reasons these all failed to pass: Congress was indifferent to the needs of the navy; some members believed that a retired list was a pension list and was not consonant with a democratic government; and the difficulty of drafting a law suitable to all the officers was very great. Secretary Bancroft was ardent in behalf of this reform. In 1846 he wrote to the chairman of the Naval Committee of the House that a "retired list, desirable in peace, was necessary in war. Why should you leave the unavailable supernumeraries to stand in the way of the promotion of young, active, and able men? I hope you are friendly to a retired list, and to the young officers of the navy. The present system puts upon the active all the hazard and toil, and gives promotions and emoluments to the idlers at home."[40]

The upper ranks of the navy had long been overstocked with old and incapacitated men, who impeded the flow of promotions. The younger officers urged that the quarter-deck was not the proper place for the "lean and slippered pantaloon" of old age. In 1854, of the 68 captains, the youngest was 56 years of age; and of the 97 commanders, 74 were between 50 and 55 years; the 327 lieutenants were from 30 to 50 years; and the 198 passed midshipmen, from 21 to 37 years. Under the then existing conditions, the lieutenants when promoted to be commanders would be 53 years of age; and the commanders when promoted to be captains would be 74 years. The incapacity for service was by no means confined to the upper ranks. Bancroft considered some of the masters "utterly ignorant of navigation." He said that in one year more than 200 warrants for midshipmen had been issued and had brought into the service "without much discrimination young persons, some of whom were even physically and mentally disqualified for duty."[41]

As a result of the incapacity of many naval officers and of the excess in their numbers, the Secretary of the Navy had virtually, without sanction of law, established a "retired list." He never sent to sea those officers who had become incapacitated by age,

[40] Congress Letters, XI, 35.

[41] Congressional Globe, 1853-1854, p. 1459; Congress Letters, XI, 5-22.

disease, or the accidents of their profession; but gave them nominal shore-duty, or else no duty at all with leave-of-absence pay. One captain who had been in the service for 54 years had been unemployed 36 years. Another officer had been a captain for 30 years, but had spent only two of them at sea. In 1848 a certain commander had not been to sea for more than 41 years; and of 67 captains, 40 were on leave-of-absence pay. For various reasons certain lieutenants were regularly passed over in the making of promotions; one had not been promoted since 1832 owing to physical and mental incompetence; and others were regularly "overslaughed" for habitual intemperance or mental derangement.[a] Of the 28 masters, 18 had never performed a cruise. The exercise of favoritism on the part of the department may account for some of these anomalies. It was a common saying in the Old Navy, that "a cruise of a few months in Washington tells more in an officer's favor than a 3-years' cruise at sea."

The act of 1855 to promote the efficiency of the navy provided for a board of 15 naval officers, composed of five captains, five commanders, and five lieutenants.[a] Under such regulations as the Secretary of the Navy should prescribe, this board was to make a careful examination into the efficiency of the officers of the line, and report to the Secretary those officers who were "incapable of performing promptly and efficiently all their duties both ashore and afloat." The board was to ascertain the character and extent of the incompetency of each incapable officer, and place him accordingly into one of three classes. Those officers who were incompetent by reason of their own fault were to be discharged from the navy; certain other officers were to be retired on furlough pay; and still others on leave-of-absence pay. The scrutiny of the board was to extend only to the captains, commanders, lieutenants, masters, and passed midshipmen of the navy. No member of the board was to examine or report upon an officer who stood higher than himself in the Navy List.

President Pierce appointed the board on June 5, 1855. Its ranking officers were Commodores Shubrick, Perry, and McCauley. Commander Samuel F. DuPont was one of its most able and prominent members. It began its labors on June 20, and made its report on July 26. It found 201 officers incapacitated. Of

[a] Congressional Globe, 1853-1854, p. 2155; 1854-1855, p. 709.
[a] U. S. Statutes at Large, X, 616-617.

these, it recommended that 49 be dismissed from the navy; that 81 be retired on furlough pay; and that 71 be retired on leave-of-absence pay. President Pierce and Secretary Dobbin approved the findings of the board, and they were at once put into operation."

This report, both in and out of the navy, attracted the most earnest attention and created a profound sensation. The feeling against the board and its action was strong throughout the country. A considerable part of the influential press took up the cause of the "degraded officers." The "Scientific American" declared that the board had struck down every officer who had distinguished himself by his scientific attainments. The legislature of New Jersey transmitted resolutions to Congress in behalf of the restoration to the active list of Commodore Charles Stewart, the ranking officer of the navy, whom the board had "reserved." The Virginia legislature resolved that the action of the retiring board "was not in accordance with the principles which our Government recognizes as the only guarantees of judicial fairness and impartiality." It found "on the list of dismissed Virginians names of men who have by their achievements in war and peace, in arms and in science, not only commanded the thanks and compliments of their own country, but had extorted, and whilst the board was in session, were extorting the homage and admiration of all the great commercial and naval powers of the world." An allusion is here found to the notable achievements in meteorology of Lieutenant M. F. Maury, who had been placed upon the "reserved list."

The dismissed and retired officers earnestly appealed to their representatives and senators to have their names restored to the active list; and when Congress assembled in December, 1855, various petitions and memorials to this effect were received by that body. Certain members of both houses warmly espoused the side of the dissatisfied officers. Senator Houston, of Texas, was a zealous, though indiscreet, champion of their cause. He declared that they were the victims of a conspiracy and that Commander S. F. DuPont was the prime mover in it. Indeed, the brunt of the opprobium fell upon DuPont. His zeal for naval reform, the excellence of his professional reputation, and his long and efficient service in the navy marked him out among the members of the board as the best target for criticism. In the Senate, Sena-

[a] Ann. Rept. of Sec. of N., 1855, pp. 10-13, 30-44.

tor Bayard, of Delaware, DuPont's State, came to his defense. That the board should have been sharply criticised was inevitable. Several of the "degraded officers" were able men and had influential friends. Moreover the cause of some of them was just. Many of the criticisms against the board, however, were most unreasonable. Its members were accused of conspiracy, favoritism, gross impartiality, jealousy, and the promotion of their own interests. That the board was moved by improper motives was never proved. It probably made errors of judgment. The brief time allotted to its work did not admit of a thorough examination of the worth of the officers. The standard for testing an officer's incapacity was, however, provided by Congress and the Navy Department; and it may have been too rigid. The board applied it rigorously and with consummate fearlessness. It undoubtedly caused some injustice. At this time, the naval officers were not familiar with a retired list. Moreover, retirement under the act of 1855 seemed to discredit them professionally. They naturally opposed a reduction of their pay.[45]

The storm of opposition could not be wholly resisted. While Secretary Dobbin and President Pierce valiantly defended the board, they nevertheless expressed a willingness to remedy all errors of judgment committed by it. After much debating, marked by many intemperate assertions, Congress finally in January, 1857, passed a law giving to each officer who had been dismissed or retired the right to have his case re-examined before a court of enquiry. This court was empowered to recommend, in accordance with the evidence presented, the entire or partial restoration of an officer to his former status. In March, 1858, the President and Senate were authorized to restore such officers as were recommended by the courts of enquiry. As a result of these laws, many officers who had been dismissed or retired were wholly or partially rehabilitated. The effect on the active list of this rehabilitation is shown by the increase in the number of officers in the higher ranks. From 1856 to 1859 the number of captains on the active list increased from 68 to 81; commanders, from 97 to 116; and lieutenants, from 326 to 338.[46]

In the end, the objects of the naval efficiency act were only in

[45] Congressional Globe, 1855-1856, pp. 386-387, 711; app., 242-245; Corbin, Maury, 110.

[46] U. S. Statutes at Large, XI, 153-154, 367-368; Navy Register, 1856 and 1859.

part attained. Under it, several incapacitated officers were permanently dismissed or retired; the reserved list of 1860 contains the names of 19 captains, 16 commanders, and 35 lieutenants. Many young men obtained promotion. On the other hand, not a few old and inefficient men still remained on the active list. The excess of officers in the higher ranks was never so great as in 1859. The naval efficiency act was a rough pruning knife, whose use caused much pain, ill-temper, and hard feelings. Had not the bitter memories of it been obliterated by the events of the Civil War, they must have long rankled in the minds of many officers.

The quarter of a century preceding the Civil War may be appropriately called the golden age of science in the navy. That wonderful movement of the last century which was marked by a passion for natural science, exact research, and the inductive method of reasoning, and which produced in England such illustrious names as Lyell, Darwin, Spencer, Huxley, and Tyndall, was keenly felt in this country and especially in our navy. During the period of 1842-1861 three important scientific bureaus were founded, several noteworthy exploring expeditions were undertaken, and more than one naval officer gained international fame for his research and discoveries.

Under the guidance of Lieutenants Wilkes, Gilliss, and Maury, the Depot of Charts and Instruments, established in Washington in 1830, developed into two scientific bureaus, the Naval Observatory and the Hydrographical Office. At this time these two offices were directed by a single superintendent. From 1844 to 1861 they were in charge of Lieutenant Matthew F. Maury, a man of much industry, fervor, and genius. During these years he accomplished his noted work in marine meteorology, and won the esteem of the savants of Europe and the gaudy decorations of numerous foreign governments. The name of Professor James P. Espy is also justly celebrated for his meteorological researches. Under the direction of the Secretary of the Navy, he made observations of the weather from stations on land and investigated the law of storms.

In July, 1849, the Nautical Almanac Office was founded, and the compilation of an American ephemeris was begun. The men most active in obtaining the new establishment were Lieutenant Charles H. Davis, the first superintendent of the office; Lieutenant M. F. Maury, superintendent of the Naval Observatory;

Alexander D. Bache, superintendent of the Coast Survey; and Joseph Henry, secretary of the Smithsonian Institution. Their prime objects were "to advance the scientific character and standing of the country by a publication of the highest order, to promote the cause of astronomy, and to render substantial services to navigation by producing a work on a higher plane than the British Nautical Almanac." In order that the new almanac might have the benefit of the scientists and libraries of the chief educational center of the United States, the Nautical Almanac Office was located at Cambridge, Massachusetts. At this time the poverty of Washington in these respects was very great. Some of the leading American astronomers and mathematicians, residing at Cambridge and elsewhere, assisted in making observations and calculations. Davis sought out and employed in his office young men of talent, without regard to political or personal influence. Several of these youths found the Nautical Almanac Office a pathway to scientific eminence. Among the famous men connected with the office during its first years, were Professor Benjamin F. Pierce, in his day the leading mathematician in America; Professor John D. Runkle, sometime president of the Massachusetts School of Technology; and Professors William Ferrel, Joseph Winlock, and Simon Newcomb, famous as mathematicians or astronomers.[47]

Of the many important exploring expeditions that were sent out in quest of scientific knowledge of all sorts, only the chief ones will be here mentioned. After four years of exploration the Wilkes expedition returned to the United States in 1842. Among other places, it visited the Madeira Islands, New South Wales, New Zealand, Friendly Islands, Samoa, Fiji Islands, Hawaii, Columbia River, Philippine Islands, and Saint Helena. It made two voyages to the Antarctic regions, where Wilkes, according to his claims, discovered an Antarctic continent. The expedition acquired much information and collected many materials relating to zoology, botany, geology, ethnography, philology, hydrography, and geography. From 1842 to 1861 several scientists and naval officers were employed in digesting and publishing this information. Commander Wilkes was still engaged in this task at the outbreak of the Civil War. The work of publication was never completed. Nineteen quarto volumes, however, were issued.

[47] Davis, Davis, 86-93; Newcomb, Reminiscences, 66.

The three volumes on zoology were prepared by James D. Dana, and one on botany by Asa Gray.

The surveying expedition of Ringgold and Rodgers, 1852-1855, consisting of five vessels, made a survey and reconnaisance of the China seas, Bering Strait, and North Pacific ocean; and collected a vast quantity of information relating to these hitherto little-known regions. In 1848 Commander W. F. Lynch explored the course of the river Jordan and the shores of the Dead Sea. In 1850-1851 Lieutenant Edwin J. De Haven conducted the Sir John Franklin relief expedition to the Arctic sea. In 1853 Dr. Elisha K. Kane, of the naval medical corps, made a similar expedition; and in 1855 Lieutenant Henry J. Hartstene went to the relief of Kane. From 1849 to 1852 Lieutenant James M. Gilliss was engaged in making astronomical observations at Santiago, Chile, with a view to the more accurate determination of the distance between the earth and the sun. In 1850-1851 Lieutenants W. L. Herndon and L. Gibbon explored the Amazon river; and in 1852-1856 Lieutenant T. J. Page made important surveys of the rivers of Uruguay, Paraguay, and the Argentine, and collected many valuable specimens of the birds, fishes, and reptiles of these countries. Commander W. F. Lynch made an exploring expedition, 1852-1853, to the West coast of Africa. In 1856 Lieutenant O. H. Berryman in the steamer *Arctic* demonstrated the possibility of laying a cable between the United States and Europe. In 1857-1858 Lieutenant T. A. M. Craven surveyed the Isthmus of Panama with a view to ascertaining the practicability of joining the two oceans by means of a ship canal. Lieutenant I. G. Strain in 1854 had made a similar expedition under extraordinary difficulties and hardships, resulting in his death.

The officers of the Old Navy were frequently called upon to settle, on their own responsibility, either through diplomacy or by the exercise of force, various troubles and disputes arising in foreign ports. These occasions now arise much less frequently than formerly. The cables and overland wires have placed our government in close communication with its naval officers and foreign representatives, and it therefore now leaves much less to their discretion. During the 20 years preceding the Civil War instances of their independent diplomatic or military action were frequent. In passing, one may refer to the palavers of Commodore M. C. Perry with the native chiefs ending in the

Berribee affair of 1843; the Nagaski incident of Commander James Glynn in 1849; Commander Duncan N. Ingraham's protection of the Hungarian refugee, Koszta, at Smyrna in 1853; and the storming and destruction of the Barrier Forts at Canton in 1856.[48]

Our greatest sailor-diplomat is Commodore M. C. Perry, whose famous expedition to Japan is well known. The command of the expedition was originally given to Commodore J. H. Aulick. In 1851 he was organizing a squadron in Hong Kong, when the department, apparently acting under a misapprehension, recalled him. He was superseded by Perry early in 1852. On November 24, Perry, after having made thorough preparations for his mission, sailed from Norfolk for the East on the U. S. S. *Mississippi*. He had been promised an imposing squadron, but the fleet which he finally brought to anchor in Yedo Bay on July 7, 1853, consisted only of his flag-ship *Susquehanna*, and three other vessels. By virtue of his tact, policy, and firmness, Perry succeeded in delivering the letter of the President of the United States addressed to the Emperor of Japan and setting forth the purposes of the mission. He then sailed for Hong Kong, having given notice that he would return in the spring. In February, 1854, he was again in Yedo Bay, this time with a larger and more imposing fleet. In March he made a treaty with the Japanese, according kind treatment to shipwrecked American sailors and permission for American vessels to anchor at certain ports and obtain supplies. Only in this limited way was trade and residence granted. The treaty was merely the entering wedge in the reopening of Japan. It was for this reason, however, none the less significant. Perry's glory consists not in originating the expedition, but in conducting it, without bloodshed, to a successful conclusion. His skill, tact, patience, and pertinacity surmounted every obstacle.[49]

A court-martial of great tragic interest was held at the New York navy-yard, beginning February 1, 1843, and lasting 40 days. The chief point which the court was called upon to decide was whether the execution of midshipman Philip Spencer, boatswain's mate Samuel Cromwell, and seaman Elisha Small, by Commander Alexander S. Mackenzie was directed and carried into effect with

[48] Naval Actions and History, 60-61.

[49] Griffis, M. C. Perry, 270-374; Narrative of the U. S. Japan Expedition.

justifiable cause. Mackenzie was the commander of the U. S. brig *Somers*. In November, 1842, when his vessel was bound from the coast of Africa for St. Thomas, he believed that he discovered a conspiracy to murder the officers and the faithful of the crew and to convert the brig into a piratical cruiser. He regarded Spencer, Cromwell, and Small as the principal conspirators, and they were placed under arrest. Certain officers of the ship, whom he directed to investigate the mutiny, advised the execution of the three ringleaders. Accordingly, on December 1, 1842, they were hung to the yard-arm of the *Somers*. The midshipman and the seaman confessed their guilt, but the boatswain's mate protested his innocence. This extreme act of discipline subdued the crew for the rest of the voyage. The court-martial, which tried Mackenzie, was presided over by Commodore John Downes, and included ten captains and two commanders. It acquitted the accused, as had also a previous court of enquiry. The public mind, however, was greatly excited over this melancholy event, and the feeling against the commander ran high. The case was aggravated by the fact that the executed midshipman was a nephew of John C. Spencer, the Secretary of War.[80]

[80] Cooper, Navy of the United States, 1866, III, 52; Defence of Mackenzie in the case of the *Somers* Mutiny; Benjamin, U. S. Naval Academy, 133.

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TORPEDO AND MINE EFFECTS IN THE RUSSO-JAPANESE WAR.[1]

Translated by PHILIP R. ALGER, Professor, U. S. Navy.

DAMAGE DONE BY WHITEHEAD TORPEDOES.

On February 8 there were 23 Whitehead torpedoes fired, of which only three made hits.

Cesarevitch (Feb. 8).—Outer plating and frames ruptured over a surface about 9 m. by 3 m. by a torpedo explosion; the armored deck deformed for a length of six frame spaces. The armor belt was pushed inward, and the frames behind it greatly deformed over a length of four frame spaces; the rear bulkhead deformed. Four compartments invaded by water. The adjoining bulkheads stood fast, and the damage was wholly local. The ship heeled 17° and it took over an hour to right her.

During the night of August 10, the *Cesarevitch* was attacked by nine torpedoes, none of which hit; their trajectories could be clearly seen on account of their luminous tracks on the phosphorescent sea.

The remainder of the Russian squadron, re-entering Port Arthur, was attacked by a squadron of 40 torpedo boats, the attacks following one after the other all night. The *Poltava* alone was struck, and had to be towed in, with her propelling machinery damaged, her rudder broken, and making water fast.

The *Diana* was attacked by torpedoes nine times without result.

On June 24, in the harbor of Port Arthur, the Japanese torpedo boats attacked eight times without making a single hit.

[1] Extract from "Les Avaries de Combat pendant la guerre Russo-Japonaise," by M. C. Ferrand, Ingénieur en chef du Génie maritime, published in the Bulletin de L'Association Technique Maritime, No. 17, Session de 1906.

On July 1 the cruiser division from Vladivostock was attacked by a small squadron, the night being clear and the attack under good conditions, but not a torpedo reached its mark.

Gromoboi.—The torpedoes had been left on board in the tubes, fully charged. Without doubt they were partially exploded by the impact of fragments, for their war heads disappeared and the spoons were found ruptured. But the ship was not injured.

Kniaz-Souvarof.—Already much damaged, she was struck by two torpedoes and sunk.

Sissoi-Veliki.—Struck by two torpedoes during the night; did not sink at once; but either sunk or was allowed to sink the next day when a Japanese division approached.

Admiral-Nakhimof, Vladimir-Monomakh.—Wrecked during the night by torpedoes; did not sink till morning.

Navarin.—Struck by two torpedoes on each side, and sunk immediately.

Sebastopol.—This ship was placed, at the end of the siege of Port Arthur, in the outer harbor, to escape bombardment from the inner harbor. She had only a nucleus crew, 300 men instead of 750, and her light artillery had been disembarked; there remained on her only the 6-inch guns. She was protected by Bullivant nets at her middle length, and by a boom defence to seaward. Sixty torpedoes according to some accounts, 180 according to others, were fired at her during five nights. A single one touched her, in the after part. The others ran head on into the net, whence they were detached and sunk by men sent in a boat. One of them struck the net near its forward end and stuck there with its screw revolving; this lifted the net, and allowed a second torpedo, fired immediately afterwards, to get by. The latter exploded against the *Sebastopol's* bow, making her sink deep in the water forward; she remained afloat, however, and was sunk two weeks later by the Russians, when they capitulated.

Transport *Sado-Maru.*—Torpedoed by the *Rurik.* A first torpedo struck abreast the machinery space, making a hole 4.87 m. by 5.18 m. Everything in the compartment—pumps, condenser, shafting—was thrown violently out of place. The bulkhead separating the machinery from the boilers was torn apart and one boiler was displaced 10 cm. to 12 cm. The second torpedo

exploded in the coal bunker forward of the starboard boiler room, making a breach 2.10 m. by 3.90 m. The explosion smashed the bunker bulkhead and displaced the boiler. Despite these damages, the ship did not sink, and the Japanese were able to get her into dock.

From all these facts it clearly follows that the Japanese torpedo boats were a failure. They succeeded, not without difficulty, in giving the coup de grâce to ships already out of action, having for their defence neither searchlights nor light artillery. They were able to approach the Russians near enough, in some cases, "to get in the dead angle of the guns and consequently to be completely sheltered." Doubtless at Tsoushima the sea was rough and unfavorable for torpedo fire, but on August 10 the sea was smooth.

It would be unwise to deduce from this lack of effectiveness the abandonment of the torpedo boat as a weapon of defence and offence. According to such accounts as we have, the Japanese torpedo boats attacked like a swarm of bees, without order or method, and fired from much too great a distance. Would it be the same with better trained squadrons, and better prepared ones? This may be questioned.

As for the Whitehead torpedo itself, it seems that the Russo-Japanese war definitely classes it as a weapon, very dangerous without doubt, but incapable by itself alone to give the decisive blow to a ship. It causes important damage, often very serious, and obliging the ship to return to port, but more than this it can rarely be expected to accomplish.

Moreover it is presumable that by certain measures it would be possible to reduce its effects to such a point that being torpedoed will mean no more than the flooding of one or two compartments, and will not put a ship out of action. The damage it does is much less than that due to a mine of the same weight, doubtless because the rebound causes the explosion to take place at some distance; it is well known how much the effect of an explosion is reduced by the least interposition of a layer of water.

Other lessons are worth remembering: The evening after Tsoushima, if the torpedo and the torpedo boat had such an easy time of it, and if they succeeded in destroying ships but little damaged, it was because the Japanese rapid fire guns had destroyed the latter's searchlights and light artillery. Too much

attention cannot be given to this fact, evident as it is, and not needing the illustration of a battle to make it known. The destruction of her light artillery will make a battleship in broad daylight easy prey for the torpedo boat. Is it so difficult to protect the light artillery, and cannot we, instead of installing it in the most exposed parts of a ship, shelter it behind armor?

The 3-inch gun battery of the Russian battleships of the *Borodino* type was, as a matter of fact, protected by 3-inch armor; was this very thin armor demolished by the Japanese fire? It is very probable; the guns had very large ports; moreover fires may have destroyed part of them. We must not be surprised if, under such conditions, the torpedo boat attacks on the *Souvarof* were successful. The rule of protecting guns by armor of thickness equal to their caliber, which appears to have been applied to the *Borodino* class, is not defensible in this case; a battleship will never be attacked by 3-inch guns. Guns intended as a defence against torpedo boats then, should be so protected that they can survive a canonade of several hours; armor of 6-inch thickness is necessary to this end; the method of keeping the light guns under the shelter of the protective deck, and mounting them as best may be when torpedo boat attacks are to be feared, seems inadmissable; in a sudden night attack one will have other things to attend to, in the midst of destruction, besides rapidly getting guns into place. At most a method of this kind might be applied to searchlights.

The incident on the *Gromoboi,* where the torpedo war heads either burned or exploded without doing much damage, is noteworthy; it shows once more that an explosion in the open has little effect. It would not be safe, however, to conclude from this that we can safely install torpedo batteries above water; the air flask is a greater danger than the explosive charge. The air flasks, however, were completely protected by the torpedo tubes from the very small fragments into which the Japanese shell burst.

DAMAGE DONE BY MINES.

Let us now consider the effects of mines.

Gromoboi.—This ship, out from Vladivostock for steam trials, struck a mine moored in 70 m. of water. The charge was 60 kilos of melinite, judging from a similar mine found at the same time on the surface. The impact was abreast the forward

boiler room, probably on the bilge keel. The resulting hole extended over seven or eight frame spaces. Outer plating and double bottom demolished; coal bunker bulkhead deformed and admitting water through rents; but the bunkers were full of coal and the water entered at a rate not exceeding 200 tons per hour, so that the pumps were able to keep it down.

Bayan.—This ship struck a mine with her bilge keel, to which circumstance her escape from injury may be attributed. In leaving Port Arthur on August 10 she struck a mine with her stern, receiving such serious injury as to have to return to port.

Sebastopol.—Having left port on June 23 to chase some Japanese cruisers, she was returning when she struck a Japanese mine, which, bursting on her starboard side, made a breach abreast her mizzen mast and 2.15 m. below the water line, from 2.5 to 3.0 m. in width and 10 to 12 m. long, having a total surface of about 37 sq. m. Her frames were twisted and destroyed and the plating projected inboard, but the ship did not sink.

The damage was entirely repaired, the frames and plating being renewed. On September 20, in a sortie, the *Sebastopol* again struck a mine which damaged her in the same place; this one made a breach of 65 sq. m.

Petropavlosk.—This ship was probably struck by three mines secured by a crowsfoot to a single mooring cable, so that in striking one of them the other two were also brought into contact with the hull. This arrangement explains the double explosion that was heard. Moreover similar mines were found by dragging in the neighborhood of Port Arthur. It is probable that the mine explosions caused some of the magazines to explode. Another explanation, very unlikely, is that there were mines stowed in her double bottom. The ship was blown up, enveloped in flames, and sunk in a few minutes.

Yashima.—Two tremendous explosions took place on the starboard side against the hull; the ship heeled 10°. The means of keeping down the water were insufficient, and the ship heeled further. Filling compartments on the opposite side only increased the draft without bringing her to an even keel. When the inclination reached 40°, there was only just time to get the crew out before she capsized and almost immediately disappeared. In Japan the loss of the *Yashima* is attributed to the impossibility of closing the doors in the watertight bulkheads,

owing to their being jammed by coal. It is also said that the ship would have been saved if she had not had longitudinal bulkheads.

Chiyoda.—A mine made an opening extending over seven frames; 20 sq. m. of the outer plating was driven in. The opening, at its greatest width, extended from the lower edge of the armor belt to the keel plating, which was itself not deformed. The explosion took place in the third compartment, between bulkheads 2 and 3, and in which is the provision room. It is the largest compartment in the ship. All the surrounding parts were destroyed or greatly damaged. The forward transverse bulkhead was uninjured, the after one slightly displaced; the water entered the coal bunker, but was stopped by bulkhead No. 4. Of three hatchways, two were closed, but one of them was not watertight. The water entered the armored deck and it was necessary to close the hatch by any means available. Bulkheads 2 and 4, which were a little weakened, were supported by stanchions. The starboard magazine was broken into and filled with water, as well as two other magazines (all in compartment 3). The projectiles were thrown about, but none were broken or burst. The shell room was three meters from the breach in the side. Seven men who were in this room were all killed, their bones being smashed. The gases of explosion entered the deck above by the ammunition passages and asphyxiated 24 men, mostly of the gun crews, so that they were unconscious for six hours. The smell of the gas was apparent even on the upper bridge. The mine charge was doubtless 60 kilos.

A torpedo boat destroyer of the *Schichau* type struck a mine abreast the officers' quarters. On account of the fine form of the hull, the uprush divided, part going on each side; the decks were pushed within less than a meter of one another, but the plating was not ruptured, and the boat did not sink.

It is worth while to give much thought to the question of automatic mines. Doubtless they are far from new weapons, but never before has their power been manifested to so high a degree. To them is due the loss of more than 60,000 tons of warships.

On the Japanese side, the *Hatsuse, Yashima, Hei-yen, Sai-yen, Takusago,* two gunboats, two torpedo boat destroyers, and two torpedo boats, or about 40,000 tons, sunk. The *Akachi* and *Chiyoda* seriously damaged. The *Asahi* slightly damaged.

On the Russian side, the *Petropavlosk, Yenissei, Boyarine,* two gunboats, and a torpedo boat destroyer, say 22,000 tons, sunk. The *Cesarevitch, Pobieda, Sebastopol, Gromoboi,* and *Bayan* seriously damaged.

Considering that the history of maritime wars teaches that their operations usually take place near the coast, and in places where the water is not deep, we ought to expect, in coming European wars, to see the use of automatic mines developed; doubtless not only naval tactics, but also naval strategy, will have to take account of this novel weapon, and surprises are in store for us. In view of the mediocre efficiency of the Whitehead torpedo, it may even be questioned whether the true role of the torpedo boat, and above all, of the submarine, will not be to strew in the path of an enemy mines similar to those which destroyed the *Petropavlosk.*

However this may be, the engineer ought henceforth to bend all his energies towards finding a means of protecting ships of war from these terrible weapons.

Three conclusions appear to result from a consideration of all the known explosions:

(1) When the surface exposed to the explosion and the resulting outrush of gas and water is a rounded one, the results are reduced.[2]

(2) The difference between the effects produced by the Whitehead torpedo, exploding after a rebound, and the automatic mine, exploding in contact, shows how much the importance of the explosion is reduced by a slight interval between the charge and object attacked.

(3) By providing an upward escape (vent) for the gases, the effects of the explosion are diverted. This fact is clearly seen by examining the *Cesarevitch* after her torpedoing on February 8.

It has been proposed, in order to make torpedoes explode at a distance from the hull, to increase the number of bilge keels, or even to place at a certain distance from the hull iron guards, forming a sort of cage with very large meshes. It has also been proposed to armor the inner skin of the double hull with plating

[2] The *Chatham,* loaded with 80 tons of explosives, and sunk in the Suez Canal, was blown up to clear the channel. Two conical buoys, placed by the side of the ship, were not injured by the explosion of the 80,000 kilos of dynamite.

about 50 mm. thick; this, it is said, will be the method adopted by the Japanese Admiralty.

We ask ourselves if a more efficient means of defense than those just mentioned would not result from enveloping the actual hull of a ship by a second, light hull, 5 or 6 mm. thick, about one meter from the inner hull, and extending one or two meters above the water line. This outer hull would be secured to the inner hull by frames, some of which would be watertight, every 10 meters say; this outer hull would have no longitudinals nor any longitudinal bulkheads at its lower part. At the water line, two longitudinals and transverse compartments would be arranged to diminish the entry of water as a result of gun-fire. In case of being torpedoed, the gases of explosion would escape through the upper part of this hull; water would enter the whole of the corresponding compartment, but the ship would remain upright and would be but slightly increased in draft. Doubtless this arrangement would increase the midship section and so diminish the speed, but there would be savings elsewhere,—part of the double bottom could be dispensed with. The forms necessary to diminish resistance would only be given to the outer hull; the inner hull would be shaped like a series of caissons with walls of simple outline, the armor plates could be parallelopipedons, not curved at great expense to fit the hull.*

We must frankly attack the problem of defence against torpedoes. If it has been, if not neglected, at least considered of secondary importance thus far, this is because the defence against torpedoes was thought to be sufficient and because the known effects of the Whitehead torpedo were such,—and the experience of war has shown the justice of this belief,—that they could be counted on not to do serious damage. The appearance on the scene of the submarine will increase, there is no doubt, the risks of being struck by a Whitehead; moreover, the automatic mine has shown itself to be a terrible engine of destruction, such as in the beginning the automobile torpedo was thought to be. *It would be unpardonable, in new ships, to devote 1000 to 1500 tons to the end of giving them a speed useless in actual battle and to economize upon the weight devoted to protection against torpedoes.*

* This plan seems to be quite impracticable. Mere subdivision is fairly effective as a defence against submarine explosions; internal armor is still better; external armor has yet to be tried and may prove entirely effective.—P. R. A.

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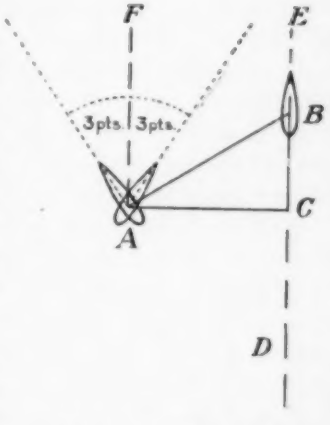
U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

A "USEFUL TABLE" FOR TACTICAL EVOLUTIONS AND FOR OTHER PURPOSES.

By LIEUT.-COMMANDER GEO. WOOD LOGAN, U. S. Navy.

The accompanying table is prepared with a view to enabling a vessel engaged in a tactical evolution by the oblique method * to determine quickly her flank distance at any point in the evolution. Incidentally, its use may be extended to afford quick solutions in certain other cases that may arise in tactics and in navigation.



Suppose a vessel at *A* (see figure) to be engaged in an evolution requiring her to take a specified distance on the flank of another vessel, *B*, of the formation, the latter steering the course *DE*. It is required that *A* shall know at any moment her flank distance, *AC*, from the line *DE*, in order that her course may be changed to "front" when the proper flank distance has been gained. Let *A* observe her distance, *AB*, from the ship *B*, by stadimeter or other instrument, and also the angle *FAB* from front to *B*—this angle being quickly determined by observing the bearing of *B* from *A's* keel line and subtracting three points (the angle of obliquing) if *A* is increasing distance, or by adding the same angle if decreasing distance. We then have the right triangle *ABC*, in which the side *AB* and

* The fact that the writer has prepared this table for assisting vessels to gain position more quickly and accurately in "oblique" evolutions is not to be regarded as an advocacy of the oblique method, nor of the practice of requiring vessels to keep such exact position in exercise as would be unattainable in action.

the angle *ABC* (= *FAB*) are known and it is required to find the side *AC*.

In the table are given solutions of the triangle for every half-point up to 8 points, at distances of 25, 50, 75, and each even 100 yards from 300 to 3200. For convenience of reference there are given in each case, besides the angle from *front*, the corresponding angle from *ahead* for a ship obliquing *out*, and the same for one obliquing *in*. The columns of distance of 25, 50, and 75 yards are intended to aid in interpolating for fractions of 100 yards of observed distance, though such interpolation may usually be made with sufficient accuracy by a little mental arithmetic. The values were taken from the traverse tables, and by the aid of these any extension of limits found necessary may be quickly made.

The following examples of the use of the table are given:

I. *Changing from column to line,* a vessel observes the guide to bear 6½ points from ahead, distant 700 yards. By reference to the table, under "angle from ahead in obliquing *out*," find 6½ points, and follow the line of the latter to its intersection with the column headed 700, at which is found 444, the required number of yards of flank distance.

II. *Closing distance,* in line of ships or subdivisions, a ship observes the guide vessel to bear 3½ points from ahead, distant 1650 yards. Under "angle from ahead in obliquing *in*" find 3½ points; abreast this, under 1600 will be found 1531 and under 50 will be found 48, the required distance being therefore 1579 yards.

III. Steering North in line, a signal is made to *change line of bearing* to N. E., distance being 400 yards. It will be convenient for a ship to determine her flank distance from the guide before attempting to oblique in to her new position; the "angle from front" is now to be four points and distance 400, 800, 1200, etc., yards for the respective ships, whence it will be found that the corresponding flank distances will be 283, 566, 849, etc., yards. Therefore oblique in until the proper flank distance has been obtained (as shown in Case II), then head to the front and drop astern or go ahead until the guide is on the proper bearing.

IV. *In navigating,* a landmark is in sight 14 miles distant to which it is required to give a clearance of 5 miles. Consider that the unit of the table is hundredths of a mile, and for 14.00 will be found 5.36 abreast 2 points (from "front"); hence, by taking the object 2 points on the bow and holding the course thus given the ship will be headed to pass the point at the required distance.

TABLE.

Observed distances.

Angles

TABLE.

Angles		Observed distances.																																				
From "front."	From ahead in obliquing *out*.	From ahead in obliquing *in*.	25	50	75	100	200	300	400	500	600	700	800	900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	2400	2500	2600	2700	2800	2900	3000	3100	3200
pts.	*pts.*	*pts.*	2	5	7	9	29	39	49	59	69	78	88	98	108	118	127	137	147	157	167	176	186	196	206	216	225	235	245	255	265	274	284	294	303	313	
½	3½	—2½*	5	10	15	19	59	78	98	117	137	156	176	195	216	234	254	273	293	312	332	351	371	390	410	429	449	468	488	507	527	546	566	585	605	624	
1	4	—2*	7	15	22	29	87	116	145	174	203	232	261	290	319	348	377	406	435	464	493	523	552	581	610	639	668	697	726	755	784	813	842	871	900	929	
1½	4½	—1½*	10	19	29	38	116	153	191	230	268	306	344	383	421	459	497	536	574	612	651	689	727	765	804	842	880	918	957	995	1033	1072	1110	1148	1186	1224	
2	5	—1*	12	24	35	47	141	189	236	283	330	377	424	471	519	566	613	660	707	754	801	849	896	943	990	1037	1084	1131	1178	1226	1273	1320	1367	1414	1461	1508	
2½	5½	—½*	14	28	42	57	167	222	278	333	389	444	500	556	611	667	722	778	833	889	944	1000	1056	1111	1167	1222	1278	1333	1389	1444	1500	1556	1611	1667	1722	1778	
3	6	0	16	32	48	63	190	254	317	381	444	508	571	634	698	761	825	888	952	1015	1078	1142	1205	1269	1332	1396	1459	1523	1586	1649	1713	1776	1840	1903	1967	2030	
3½	6½	½	18	35	53	72	212	283	354	424	495	566	636	707	778	849	919	990	1061	1131	1202	1273	1344	1414	1485	1556	1626	1697	1768	1838	1909	1980	2051	2121	2192	2263	
4	7	1	19	39	58	78	232	309	387	464	541	618	696	773	850	928	1005	1082	1160	1237	1314	1391	1469	1546	1623	1701	1778	1855	1933	2010	2087	2164	2242	2319	2396	2473	
4½	7½	1½	21	42	62	83	249	333	416	499	582	665	748	831	915	998	1081	1164	1247	1330	1413	1497	1580	1663	1746	1829	1912	1996	2079	2162	2245	2328	2411	2494	2577	2660	
5	8	2	22	44	66	88	265	353	441	529	617	706	794	882	970	1058	1146	1235	1323	1411	1499	1587	1676	1764	1852	1940	2028	2117	2205	2293	2381	2469	2558	2646	2734	2822	
5½	8½	2½	23	46	69	92	277	370	462	554	647	739	831	924	1016	1109	1201	1293	1386	1478	1571	1663	1755	1848	1940	2033	2125	2217	2310	2402	2494	2587	2679	2772	2864	2957	
6	9	3	24	48	72	96	287	383	478	574	670	766	861	957	1053	1148	1244	1340	1436	1531	1627	1722	1818	1914	2010	2105	2201	2297	2392	2488	2584	2679	2775	2871	2967	3063	
6½	9½	3½	25	49	74	98	294	392	490	588	687	785	883	981	1079	1177	1276	1373	1471	1569	1667	1765	1863	1962	2060	2158	2256	2354	2452	2550	2648	2746	2844	2942	3040	3138	
7	10	4	25	50	75	100	300	398	498	597	697	796	896	995	1095	1194	1294	1393	1493	1592	1692	1791	1891	1990	2090	2189	2289	2388	2488	2587	2687	2787	2886	2986	3085	3185	
7½	10½	4½	25	50	75	100	300	400	500	600	700	800	900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	2400	2500	2600	2700	2800	2900	3000	3100	3200	
8	11	5	25	50	75	100	300	400	500	600	700	800	900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	2400	2500	2600	2700	2800	2900	3000	3100	3200	

* Negative angles are measured from ahead on *opposite* side to that toward which the ship is closing.

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STAR-FINDING DIAGRAM.

By LIEUT.-COMMANDER ARMISTEAD RUST, U. S. Navy.

This diagram has been prepared to simplify the method for the indentification of stars described in No. 123 of the U. S. NAVAL INSTITUTE and shows the relation

$$\text{Sin t cos d} = \text{sin Z cos h};$$

from which the declination is found after finding the hour angle from the Azimuth Tables—the azimuth having been observed or found from the Azimuth Diagram.

2. *To Find the Star's Declination from the Diagram.*

Enter with the azimuth on the margin; the intersection of the horizontal line through this point with the curve corresponding to the true altitude fixes a vertical line, the intersection of which with the horizontal line corresponding to the hour angle previously found, determines the curve corresponding to the declination of the body.

3. Thus in Problem 1, we have Azimuth = N. 74°W.; Hour Angle = 72°24′ and Altitude = 29°30′ and we find the Declination = 28°30′.

Problem 2. Azimuth = S. 110°25′W.; Altitude = 19°51′20″; Hour Angle = 64°30′; hence we find the Declination = 12°30′.

Problem 3. Azimuth = S. 64°37′E.; Altitude = 25°55′; Hour Angle = 58°04′; Declination = 16°15′.

4. Referring to the Azimuth Diagram published in No. 123, and to paragraph 5 of the paper referred to above:

The Azimuth may be named without reference to its sign by the following precept:

Mark the Azimuth East or West like the Hour Angle.

When the Latitude and Declination are of the *same* name and

the Latitude is greater than the Declination and when the Declination is of the *contrary* name to the Latitude—then the Azimuth is of the *contrary* name to the Latitude.

When the Latitude and Declination are of the *same* name and Latitude is less than the Declination and near the Inferior Meridian—then the Azimuth is of the *same* name as the Latitude.

5. By using formula

$$\text{Sin } Z \cos L = \sin M \cos d \qquad (2)$$

the Position Angle M of a given body may be found, thus:

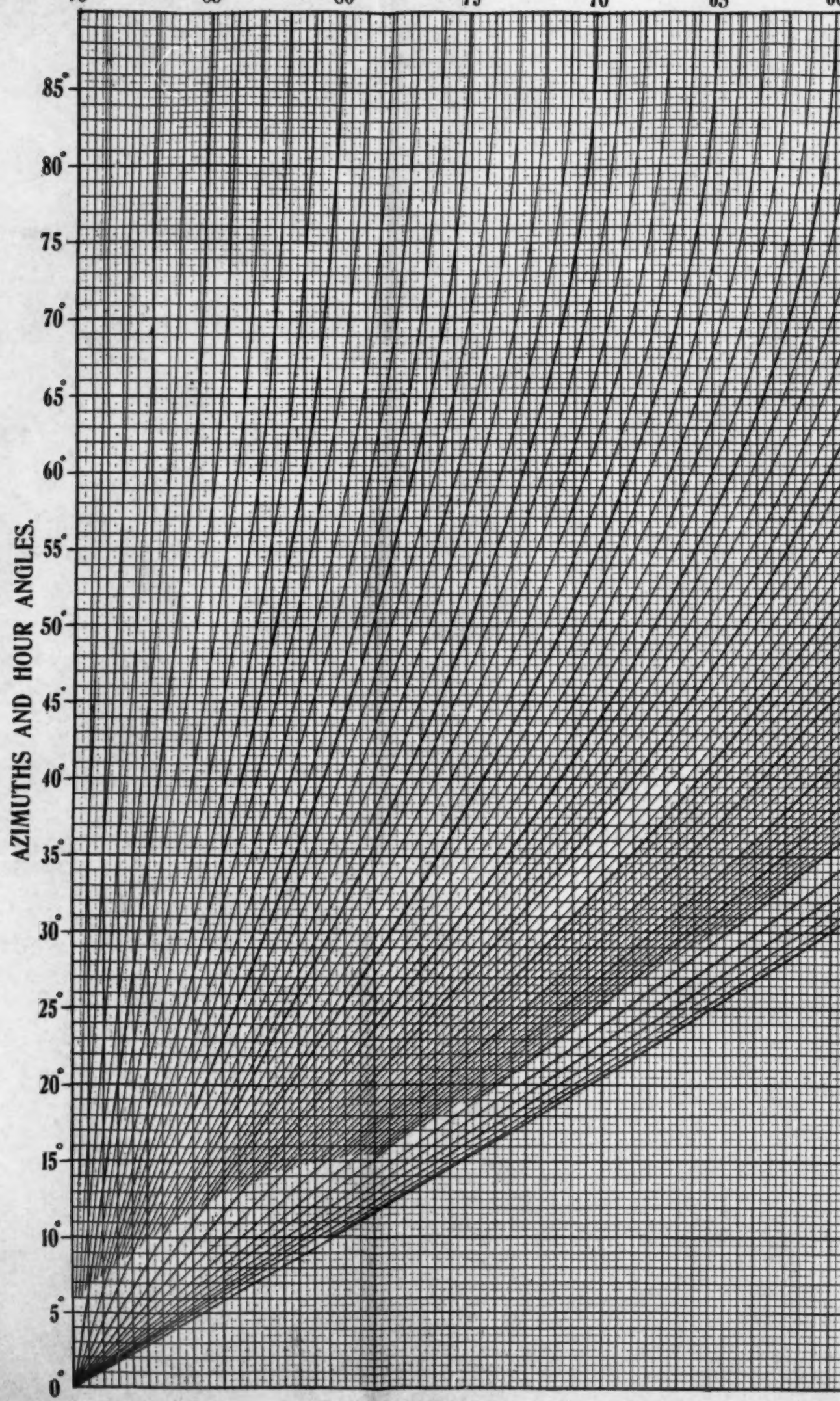
Enter with the azimuth on the margin; the intersection of the horizontal line through this point with the curve corresponding to the Latitude fixes a vertical line the intersection of which with the curve corresponding to the given declination determines the horizontal line corresponding to the Position Angle of the body.

Supplementary Azimuths, Hour Angles, and Position Angles are given on the right hand margin.

For convenience in use, and in order to preserve the diagram, it should be mounted on heavy cardboard.

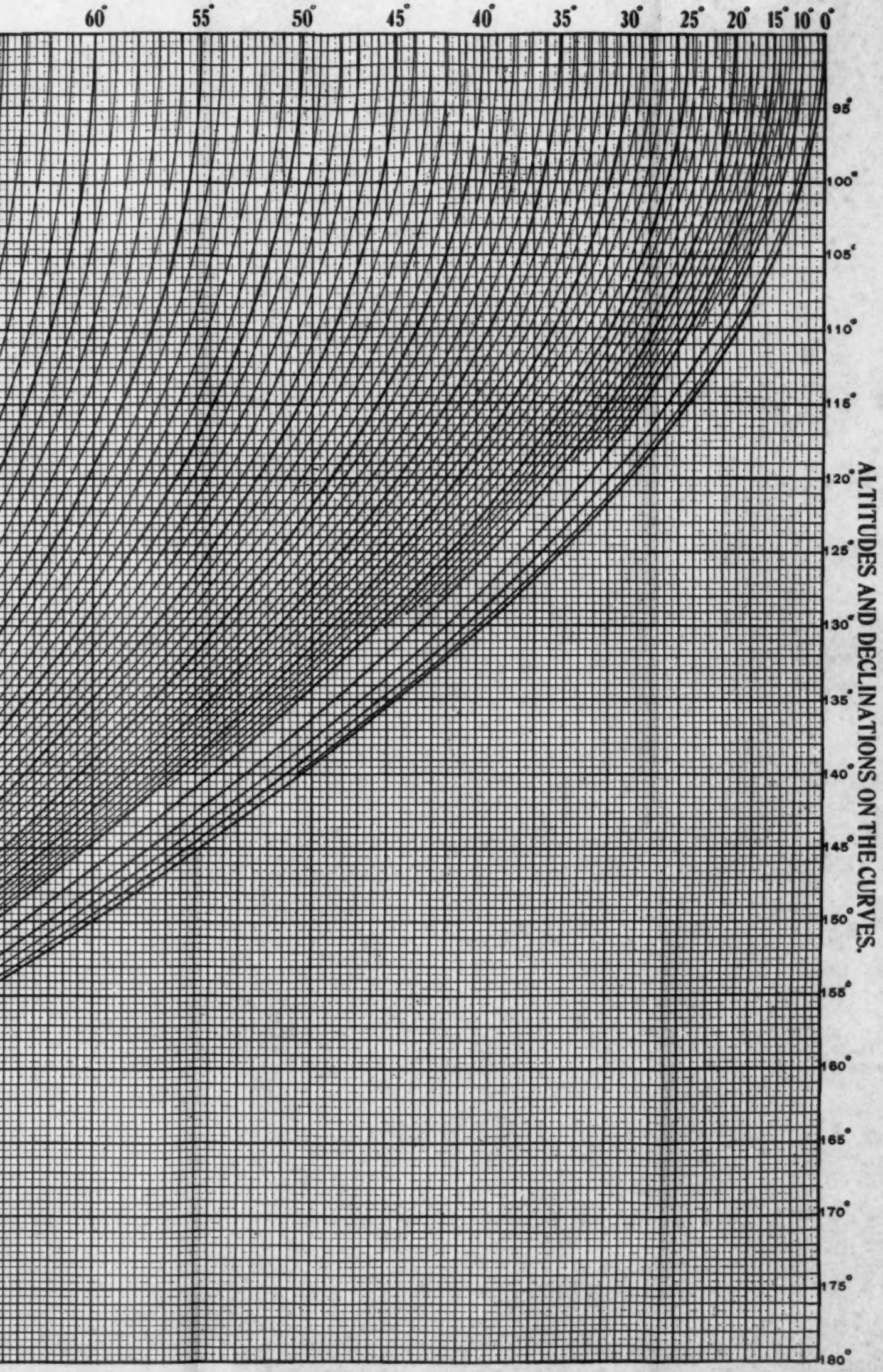
IAGI

STAR-FINDE



Formula (1) Sin z cos h = sin t cos d; Fo

FINDING DIAGRAM.



cos d; Formula (2) Sin Z cos L = Sin M cos d.

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SOME REMARKS ON REAR-ADMIRAL GOODRICH'S ARTICLE, "AIDS TO CONTENTMENT IN THE NAVY."*

By LIEUT.-COMMANDER A. B. HOFF, U. S. Navy.

Having just finished three years with the modern sailor-man under modern conditions, I am tempted into what may well seem a presumption, namely, a desire to add a few remarks to Admiral Goodrich's article on "Aids to Contentment in the Navy."

Admiral Goodrich is the distinguished leader of those who are endeavoring to bring the laws and regulations for the personnel of the navy, in their opinion, up to and abreast the times. Outside of his own forceful and pertinent remarks and together with them, he has done a good service in again bringing attention to the able article in last December's PROCEEDINGS by Lieut.-Commander McLean. This masterly summary is practically the whole situation in regard to the enlisted personnel.

It should be earnestly hoped by all, that the Department will soon take up these vital matters.

As an "Aid to Contentment" it is not so much the laws and regulations that count, as the way they are administered. This will always be so. However, in order to minimize inefficiency in this direction, we should strive to get those laws and regulations best suited to draw into the navy, and retain there, the present market in young American men.

It is evident that desertion is the plainest expression of discontent. About two-thirds of all our military offences are desertions, and about one-half these are desertions in the first six months of enlistment.

Remedy.—Have a probationary period of six months, to be in a ship in active service, during any time of which a man can can-

* See No. 123.

cel his engagement with the government. At the end of six months the oath of allegiance is taken and the man becomes sworn to the service.

Again, a great deal of discontent is caused, I believe, by the extreme youth of our men. The majority of them are too young to be well balanced. This is especially to be noted with the coal passers, whose hard work is a man's job.

Remedy.—No coal passers, and only a smaller proportion than at present, of other enlisted men, to be *under* 21 years of age.

If the above two regulations were put into force (and they require no legislation), we would have at once in the navy (1) more contented men, and (2) more mature men, with which, by means of perhaps more modern laws and regulations, we could obtain greater efficiency.

Section III of Admiral Goodrich's article is such an entire summary of the necessities of modern conditions, that it is delightful reading. There is one point, however, in which I presume to differ with him, and Lieut.-Commander McLean. I have found from actual experience that "extra duty" is an extremely efficacious punishment, if rightly administered.

Of course it can only be applied to unrated men in certain duties. The plea against this form of punishment has always been that it punishes some one else. This I consider a wrong view of the matter.

The ship's police is not *punished* when it arrests, confines, or polices prisoners; or inspects decks and localities to prevent infractions and irregularities.

The paymaster's, or ships writer's people are not *punished* when they have to do paper work connected with punishments, absentees, paying rewards, and so forth.

The executive officer is not *punished* when he has to attend to numerous matters connected with punishments. Neither is the captain *punished* because he has to come up on deck out of his cabin and assign punishments. It is all in the day's work, and the enforcement of extra duty belongs to those connected with such matters on board ship.

The fact is that too often extra duty is given as punishment, and then not properly regulated. Its enforcement is more or less haphazard. It is a convenient way of getting rid of annoying small reports.

I fear that this worse than useless method is what has given it a bad name.

In Section IV the Admiral has, I think, not quite gotten in touch with the present spirit of giving liberty that has been in the Atlantic fleet for the past two years and a half.

It is extremely liberal. It is hardly ever dependent on the captain, but on the admiral, who regulates it by signal. The privileged men get generous liberty, whenever circumstances allow. A long step in the right direction, however, would be gained if deprivation of liberty on shore were not a *regular* punishment. The method of having classes for money and classes for liberty, recommended in the article under discussion, is an old one in the British navy, where it is now used. It could be adopted without legislation, if thought desirable. But *is* it desirable to keep a man's wages (other than a month's pay) away from him? The system of fines would obviate this.

Certainly to gain an efficient contentment the greatest amount of liberty should be given in ports where it is feasible, and it always is feasible, except where political, sanitary or military reasons make it impracticable.

As regards contentment liberty can also be granted on paper that is almost worse than not going ashore.

Here is a case where a good law may be badly administered. For instance, I have been in ships where, at a navy-yard, the men were made to come back at 6.00 a. m., and if they came back any time during the night they were made to turn out just the same at 4.30 or 5.00, and wash down.

This is a discontent-breeder. Certainly men whose privilege it is to go ashore should be allowed to take their meals and sleep on board. It ought to be better to sleep at one's home rather than in a lodging house. A part of the deck could be reserved for liberty men, where they may sleep in till six bells and where they *must* sleep if they don't wish to be disturbed.

No lying around the decks in the working-people's way.

In home ports certainly, a "free gangway" (so called) is the thing; and *fines* for those who abuse it.

"Chronic leave breakers should be discharged."

Would it were so! Leave-breaking is a thing that would not be put up with one minute in an industrial concern. In our own

navy-yards a man six days absent is discharged. Yet we are always hearing that our ships should be run as a vast industrial workshop. So they should be, but as a military workshop. There is the difference.

If a young man enters the navy voluntarily, he voluntarily gives up certain vested rights. But do not forget that he also gets a hold on his job that he would never have for a moment in civil life. Lieut.-Commander McLean shows how hard and impractical it is to get a man discharged after he is once enlisted.

Let him be anything under a certain degree of slovenliness, stupidity, incompetency, unreliability, intemperance, and a leave-breaker—let him be any or all of these things, in any but a superlative degree, and the laws and regulations give him three good meals a day for four years as a sure thing.

Where is the industrial workshop you can get a guarantee like that?

Is this an "Aid to Contentment" for the vast majority of such people's shipmates, who are well meaning and obedient?

In Section VII Admiral Goodrich discusses what I believe to be as fruitful an "Aid to *Dis*contentment" as anything else on board ship. I refer to the question of "clothes."

And not nearly so much the clothes themselves, as the prescribed occasions for wearing them.

As the Admiral says: "It is high time to put a stop to this nonsense." I suppose that he here refers to the present fleet and deparmental regulations regarding uniforms.

Those that have read Lieut.-Commander Stirling's capital lampoon in the "The Navy," may recall the story of the gunner's mate who rushed momentarily out of the turret to fix the Morris tube gear. He was in dungarees. The "fixing" took a couple of minutes, but unfortunately the man ran into the captain.

Now the flagship was near and the admiral might have seen this flat disobedience of his positive orders that dungarees were not to be worn in sight on deck. Result—"five days bread and water." This is an actual fact.

Such action as this must be due to misconception of what clothes are given to us for.

While speaking about these "Aids," why not the following:

1. When working, wear dungarees. "There's a reason."

2. When not working, wear ordinary ship's dress.

3. When on liberty or dressed up, wear your 11-inch cap and dress up to the limit. Be smart and smiling.

4. And as regards head-gear, why not turn hat brims *down* in the sun so as to shade the eyes? The present regulations require them to be turned *up*. What are hat brims for?

5. Why wear the watch cap at all? What function does it fulfill? In cold weather it is cold. It is always uncomfortable, and it musses the hair! This last reason has been given to me many times by men as a reason why they hate watch caps. It was introduced in 1886, I believe, as a head-gear for topsail yardmen.

6. And again this oft repeated tale! Why not have a blue hat like the white hat. Why is it the men like white hats with "blue" way into the cold weather, better than any blue head-gear? Because it is the most serviceable and comfortable of all. It shades the eyes and can be jammed down on the head. And that is what a working hat should be. Look at any civilian workman using machinery and see if those two things are not the prominent features of his head-gear.

7. Except for "dress," why wear the most unserviceable head-gear ever designed for a mortal to do anything in, but stand around. I refer to the 10-inch stiff grommetted flat cap. For traditional "dress," however, retain it by all means, but for this only—as it is a very killing thing when properly cocked over the eye.

8. And again, why should any but dress sleeves have a positive hindrance-to-work attached to the end, in the shape of "cuffs?" It is incredible.

The working deck-hand nowadays, in his ordinary blue undress, in which he has to do all sorts of greasy, dirty work, is not a pleasant nor workmanlike sight. Stained and ragged trousers, dirty cuffs rolled back, neckerchief (an old one of course) tucked in his shirt, shirt with grease stains, and to crown all, a flat cap.

It is absolutely imperative on his officers to make him wear these clothes. They have no alternative. If he had on some kind of working clothes (over old blue of course, if it were cold), he would at least look like a workman doing a man's work.

9. In this connection, why should side cleaners wear anything

but oilskins or white—to suit their work in other words? I have seen them made to wear "undress blue"—cleaning a white side with soap!

10. Why should cooks and hospital men when at work ever wear anything but white as an outside rig? And why should there be any crime against sticking their head above the rail in this costume, even if the regular uniform of the day *is* "blue?" Certainly to get the best work out of men you should dress them suitably and for the work in hand.

11. Why make men wear infantry marching boots for *all* purposes? This is one of the most important of all these questions,—as Lieut.-Commander McLean shows.

12. Why should there be any objection to C. P. O.'s, and men generally, in home ports, where practicable, wearing civilian clothes? We would get some good men under these circumstances.

13. Why not have dungarees (i. e., working clothes) made of khaki material? There is no essential point in blue. We should then have the additional advantage of a suitable landing rig for the men.

The above are the main points that have been thrust at me during a three-years' tour just completed in the fleet.

Personally I am thoroughly convinced that their adoption would be a great "Aid to Contentment" in the service.

Also, I believe there is nothing in the above that would make a crew other than well dressed, clean and smart. These things depend on the officers, not on the regulations. As do also micrometer measurements and the application of the protracter.

Lieut.-Commander Plunkett's idea regarding daily general quarters, is an attractive step towards that efficiency for which we are all striving, but it seems to me five times a week would interfere too much with unit drills and repair work, whose importance is too evident to comment on.

9.15 is an evil time to break into the general and administrative work of the ship, which, to keep her up to the mark as a fighting machine, must always be going on. Breaking off at 9.15 every day to go to quarters, for men actually at repair work and not needed for unit gun drill, is fatal to the good work of all mechanics—electricians, engineers, commissary men, gunner's people,

etc.—and impairs the ship's efficiency to just so much. Only about half work is accomplished under these circumstances.

I expect it is *this* case that the Admiral refers to when he says that he sees no reason for 9.15 a. m. inspection. If he refers to an inspection of the sort that is common in many ships, where everyone must drop everything, dress up, and fall in to see that their shoes are blacked, and then go to a dirty drill in clean clothes—I most heartily agree with him. There is absolutely no sense in this that I, personally, can see. However, I believe that it is necessary to set a time for "Fall in and Muster" (so to speak).

This must be a time by which the ship is usually cleaned up ready for the day. It is the time the muster of absentees is made. It is the definite military pivot, this lining up in ranks, with the officers in charge, and the real progress toward "Fighting Efficiency" about to begin. It instills that cohesion which is the aim of all discipline.

In certain cases when lying at a navy-yard, and there is only an 8.15 muster, and no chance to drill nor line up, the men and everything else get markedly slack.

In fact I see no aid to contentment (and hence efficiency) in "General Quarters" *five* times a week, and the abolition of a *practical* forenoon "line up" and muster.

As an "Aid to Contentment," in home ports, Sunday should, I believe, be given as a "day off" as much as possible. Let inspections be other days, if needful. I refer to "functions," not the incessant inspections of ship and material necessary to efficiency. For instance, don't keep all hands on board to attend "Articles of War." Have the function with those on board. Everyone reads in these literate days.

And as "Aids to Contentment" how about the number of inconsequential drills? Those that befog the intellect, and waste valuable time. It is a large subject. The unimportant drills are given a prominence and require an amount of practice out of all proportion to their importance. Why? Because perfection in them as to minor points is insisted upon, and lapses or mistakes in them are counted equal with, the "fighting efficiency" of the ship. There are altogether too many of them.

But to go back—the greatest "Aid to Contentment" is a well-regulated discipline, practically administered.

Without that nothing much can be done. But poor work in this direction may be minimized, if Lieut.-Commander McLean's admirable summary were acted upon.

Let us hope that something of this sort *will* be done, so that by a more permanent enlisted force we may be able to better maintain ourselves in line of battle, and that more hits per minute, at battle ranges, may be made than ever before.

Drills, money, punishments, clothes, liberty, food.

But the greatest of these is food.

THE ANNUAL MEETING OF THE INSTITUTE.

U. S. NAVAL ACADEMY, ANNAPOLIS, MD., Oct. 11, 1907.

The annual meeting of the U. S. Naval Institute, held on the above date, was called to order by Captain Chas. J. Badger, U. S. Navy.

Twenty-four members were present.

The Secretary, Professor P. R. Alger, U. S. Navy, announced that the first business was the election of officers, and stated as follows: The Board of Control this year, considering the fact that at the annual meetings there can be only a very small attendance—there being only a few members in this vicinity and the meeting usually consisting of only eight or ten, or a dozen at the outside—decided that it would be desirable to try to get up a more general service interest in the election of the Institute's officers by asking absent members to vote by proxy. The constitution requires a notice to every member, wherever he may be, to the effect that an annual meeting is to be held at a certain time; and, consequently, it was not a great extra trouble or expense to accompany that notice with a request that they vote, and the enclosure of a card for a proxy vote. The difficulty is that people out in the service generally do not know much about who is here or how to vote. This year the Board decided to send out a list of present incumbents, and the natural result of that was that almost everybody who took the trouble to vote voted for that list. We have received some 375 or 380 proxy votes, and they are almost all for the present incumbents.

Lieut.-Comdr. H. G. Gates: I would like to ask if an amendment to the constitution, with regard to qualifications of membership for the Board of Control, would be in order.

The Chairman: I think not. The constitution must provide some method of electing a Board of Control, and any motion looking to a change of that would be a change in the constitution. I think that at this meeting the Board of Control will have to be elected in accordance with the present constitution.

The election of officers was then proceeded with, the Chairman

appointing Lieut.-Comdr. E. L. Beach and Lieut.-Comdr. L. M. Nulton as tellers. Then followed the voting. After the votes had been counted, Lieut.-Comdr. Beach announced the result of the election to be as follows:

The total number of votes cast was 402. For President, Rear Admiral C. F. Goodrich, U. S. N., received 366 votes.

For Secretary and Treasurer, Professor P. R. Alger, U. S. N., received 389 votes.

For the Board of Control, Comdr. W. F. Worthington, U. S. N., received 223 votes; Comdr. W. S. Benson, U. S. N., 248 votes; Lieut.-Comdr. W. G. Bullard, U. S. N., 245 votes; Lieut.-Comdr. E. L. Beach, U. S. N., 241 votes; Lieut.-Comdr. H. J. Ziegemeier, U. S. N., 235 votes; and Prof. N. M. Terry 213 votes. All other votes were scattering.

The small number of votes received by members of the Board of Control was due to the fact that many proxy votes were cast only for President and Secretary and Treasurer.

The Chairman: The officers named by the tellers have been elected. The next business is "Reports of Officers."

The Secretary and Treasurer reported as follows: During the year which ended September 30, 1907, the total receipts were $30,146.53, which was practically $7000 less than the receipts of the preceding year. The balance on hand a year ago was $24,178.69, so that the total sum available during the year was $54,325.22. The expenditures were $26,054.48; balance on hand $28,270.74. Bills receivable amount to $5315.44, and liabilities are approximately $3177.30. The bills receivable include $1225 for dues, and 3591 for books. You will see, as I said, that the receipts for the year are $7000 less than the previous year. The expenses are a little over $3000 less. That is due to the fact that during the year ending September 30, 1906, the Institute printed the new drill books for the Navy Department, of which the sales amounted to $6000 to $7000, if not more, and that made the large receipts. The increase of cash assets in the previous year was about $4000, and this year about $2000. That comes from the fact that the numbers this year cost more than they ever did before,—they have been larger and more expensive. The number of regular members is 698, of life members 131, associate members 147, and honorary members 3, making 979 in all. The number of subscribers was 401 and of exchanges 114,

making a total of 1494, besides which, during the year, we sold 285 individual copies. During the year 15 members died and 30 resigned. There was a considerable increase in the number of subscribers during the year, and a small falling off in the regular members, the total increase amounting to 23. There were 23 more actual people who received the numbers than last year. In connection with our excess of receipts over expenditures, I have heard that many people think it a great mistake for the Institute to attempt to build up a surplus. The reason why I think we should endeavor to build up a surplus is this: We cannot get out the four quarterly numbers on anything like the scale on which they are now gotten out for the money which the members pay in. It costs on an average $1200 to print an edition of the number, and that is without counting paying for the articles. As a matter of fact, the four last numbers issued, including payments to authors for articles, cost $6912.96, so it would not be safe to count on less, if we want to keep up this scale, than $7000 a year for the publications of the Institute. Besides that, of course, are the office expenses, which include the salary of clerk, messenger, Secretary and Treasurer, and other incidental expenses, amounting to easily $3000 a year. So that we really need $10,000 a year. From subscribers we receive approximately $4000—I mean from subscribers and people who buy numbers—and from advertisements we receive about $1000 a year. So we need in some way to make up that difference. For a number of years past we have more than made it up by the sale of books which we have printed. We have made large profits from these books. We have an income from our investments of about $1200 a year, which helps out. It seems to me that it would be a very good thing if we could get to a point where the income from our investments would make us independent of any other receipts than the annual dues of members.

On motion by Commander H. McL. P. Huse, seconded by Commander W. C. P. Muir, that the report be approved, the motion was duly put by the Chairman and carried.

The Chairman: The next business is the election of associate and life members.

The Secretary read the names proposed, as follows:

Mr. L. E. Wiman, Schenectady, New York, proposed by Ensign W. S. Anderson, U. S. N.

Sir William White, London, England, proposed by Naval Constructor D. W. Taylor, U. S. N.

Mr. E. Schelling, Bar Harbor, Maine, proposed by Lieut.-Comdr. M. L. Bristol, U. S. N.

Prof. Wm. Hovgaard, proposed by Naval Constructor D. W. Taylor, U. S. N.

Captain P. Duart, Island of Guam, proposed by Lieut.-Comdr. R. Stone, U. S. N.

Mr. W. E. Kimball, Wollaston, Mass., proposed by Prof. P. R. Alger, U. S. N.

Mr. J. C. Schwab, proposed by Prof. P. R. Alger.

Chief Engineer W. E. Maccoun, R. C. S., proposed by Lieut.-Comdr. J. F. Carter, U. S. N.

M. F. B. Philbrook, Jay, New York, proposed by Prof. P. R. Alger, U. S. N.

Mr. J. T. Williams, Washington, D. C., proposed by Naval Constructor R. H. Robinson, U. S. N.

Captain Le Vert Coleman, U. S. Army, proposed by Major J. W. Ruckman, U. S. A.

Mr. Geo. L. Selden, Lawrence, Mass., proposed by Mr. T. C. Wood, member of the Institute.

The Chairman: You have heard the names of candidates for election as associate members. Is there an objection to any one of the names?

Commander W. S. Benson: I would like to ask if they are all strictly eligible according to the constitution.

The Secretary read what the constitution says about associate members.

Lieut.-Comdr. H. G. Gates asked about the qualifications for life membership.

The Secretary read what the constitution says about the election of life members.

Lieut.-Comdr. E. L. Beach objected to the election of any more life members, on the ground that the Institute loses on every life member. The $30 paid for life membership, at four per cent, brings in only $1.20 a year, while the four volumes which the life member receives cost the Institute about $5 to publish.

After further discussion it was moved, seconded, and voted that only associate members be elected at this meeting.

Commander Huse: I move that the subject of life membership

be referred to the Board of Control with directions to report at the next annual meeting as to who shall be eligible and what the cost shall be.

The Secretary: The present constitution was drawn up by the Board of Control several years ago. The Board considered that matter very carefully. I was a member, and proposed that the fee should be increased; but the Board decided not to do so. It was thought that it was desirable to get life members.

Lieut.-Comdr. H. J. Ziegemeier: I move that this matter be referred to the Board of Control for their action and, if they think proper, an amendment to the constitution.

This motion was seconded, duly put by the Chairman, and carried.

It was moved and seconded that the candidates for associate members, read by the Secretary be elected. Motion was duly put by the Chairman and carried.

Professor Alger: I move that Mr. A. R. Bush, of Malden, Mass., be elected an associate member of the Institute. Motion seconded by Lieut.-Comdr. Beach, duly put by the Chairman, and carried.

Commander W. C. P. Muir submitted the following resolution: *Resolved,* That it is the sense of this meeting, and in view of the prosperity of the Institute, that the Board of Control consider the advisability of raising the present salaries of the clerk, Mr. Conroy, and the messenger, Mr. Jacobson.

The Secretary: The clerk of the Institute gets $110 a month, and the messenger $25 a month.

Commander Huse suggested that the salary of the Secretary and Treasurer should also be raised.

The Chairman: The motion before the meeting now is the question of the salary of the clerk and the messenger, and I shall be glad to hear a motion for the Secretary later; but the question now is whether the Board of Control shall consider the advisability of increasing the pay of the clerk and the messenger of the Naval Institute. As I understand it, it is left to the Board of Control to decide either way.

Lieut.-Comdr. Beach: Mr. Conroy has been employed by the Institute for twenty-one years, and I am sure that I voice the opinion of every one having knowledge of the subject, that he has been a most valuable clerk. He has handled a great deal of

money, and for over six months during the Spanish War he ran the Institute entirely.

The Chairman: Can the meeting fix his salary?

The Secretary: The Board of Control has the management of all the financial affairs of the Institute.

Commander Huse: I have the consent of Commander Muir to substitute the following for his original resolution, That the question of salaries paid by the Naval Institute be referred to the Board of Control with the recommendation that they be suitably raised.

The Chairman: The resolution is that the question of all salaries paid by the Naval Institute be submitted to the Board of Control with the recommendation of the meeting that they be raised.

Lieut.-Comdr. Beach: I do not think that the salary of the Secretary and Treasurer should be raised. I will add that in making this statement I am expressing the views of the present Secretary and Treasurer, Professor Alger.

The Chairman: The motion now before the meeting is that all salaries paid by the Naval Institute be referred to the Board of Control with the recommendation that they be raised. Motion duly put by the Chairman and not carried.

Commander Muir again read his resolution.

The Chairman: The motion is that the Board of Control be directed to consider the advisability of raising the pay of the clerk and messenger. Motion was duly put and carried.

The Chairman: Is there anything more before the meeting?

Lieut.-Comdr. Gates: I would like to propose that an amendment to the constitution be submitted to the members of the Institute for vote, restricting the qualifications of membership of the Board of Control to officers on the active list of the Navy.

The Chairman: To amend the constitution, you must have at least half the votes of the entire membership, and at least two-thirds of the votes cast must be affirmative.

Lieut.-Comdr. Gates' motion was here seconded by Commander Muir.

Commander W. S. Benson: The only way that this can be brought before the members of the Institute is for Mr. Gates to submit his ideas to the Board of Control, and have the Board of Control thrash the matter out, and then determine on some

line of action. The constitution of the Naval Institute is lacking in defining how amendments to the constitution shall be proposed, and, as I understand it, any member who wants an amendment voted on should submit it to the Board of Control.

Commander Muir said that he was not on the active list, being a retired officer, but that he thought an association of this kind should be controlled by officers of the Navy on the active list. He seconded Mr. Gates' proposition.

Commander Benson stated that, in his opinion, the retired officers were a great help to the Institute and, if anything, they increased their efforts to help along the general interests of the service; and that he was in favor of moving the Institute to Washington so that the large number of retired officers living there could be in closer touch with the Institute.

The Chairman: A motion has been made by one of the members present to amend the constitution. The question is as to the proper method of submitting that amendment to the members of the Institute, and the constitution seems to be indefinite in the matter. It is a question of procedure. I, therefore, propose to submit to the members here the question whether the amendment presented by Lieut.-Comdr. Gates shall be voted upon by this meeting, or whether it shall be submitted to the Board of Control, as suggested by Commander Benson, and settled there. The first motion I desire a vote on is whether the sense of this meeting is that the amendment should be submitted to the meeting. All those in favor of submitting the question to this general meeting will please say "Aye."

The motion was not carried.

The Chairman: The motion now is whether it shall be submitted to the Board of Control to decide, Lieut.-Comdr. Gates to make his motion to them, and the Board of Control to decide. All those in favor of leaving the motion of Lieut.-Comdr. Gates to the decision of the Board of Control will please so vote. The motion is carried, and the Board of Control will consider the proposed amendment.

Lieut.-Comdr. Bullard: The constitution provides that amendments shall only be considered in one way, and that is by submitting them to the members.

The Chairman: That is what I am striving to get at,—some way to get an amendment before the Association. What is the process?

Then followed a lengthy discussion as to the manner in which amendments to the constitution should be proposed.

It was finally decided that proposed amendments to the constitution should be voted upon by the meeting and that two-thirds of those present must vote affirmatively in order to bring about the submission of the proposed amendment to the Institute as a whole.

Prof. P. R. Alger then moved that it be submitted to the vote of the meeting whether Lieut.-Comdr. Gates' amendment shall be submitted to the members of the Institute. This motion was carried.

The Chairman: The question now is, Shall an amendment to the constitution, restricting the qualifications of membership of the Board of Control to officers of the active list of the Navy be submitted to the members of the Institute for vote. The motion was duly put by the Chairman, and, less than two-thirds of those present voting in its favor, was not carried.

Lieut.-Comdr. Yates Stirling, Jr.: I submit as an amendment to the constitution that the Board of Control be selected from officers of the Navy, either active or retired.

This amendment was seconded by Pay Inspector T. J. Cowie, and was voted upon by the meeting, but, less than two-thirds of those present voting in its favor, it was not carried.

There being no further business before it, the meeting then adjourned.

DISCUSSION

A Simplified Method of Finding the Equation of Equal Altitudes.

(See No. 123.)

H. B. Goodwin.—With reference to the interesting paper by Mr. G. W. Littlehales entitled "A Simplified Method of Finding the Equation of Equal Altitudes," which appeared in the September number of the Proceedings may I be allowed to point out that even previously to the publication of the extended Azimuth Tables, the advantages of the single term expression for the "Equation," in preference to the very cumbrous double barrelled form generally employed, had not altogether escaped observation. Some twenty years ago in a paper by the present writer contributed to the *Nautical Magazine* the same form of expression now advocated by Mr. Littlehales was suggested, and the simplification which resulted, more particularly with regard to the ease with which the algebraic sign of the expression is determined, was pointed out. The extension of the Azimuth Tables to include all latitudes up to 70°, which is indeed an epoch-making work, has still further simplified the problem, since, as was mentioned in the article above alluded to, the Azimuth Tables could formerly be made available to calculate the position angle in tropical latitudes only. Under the new conditions it is probable that the supersession of the old formula by the new one is only a matter of time.

The following extract from the third edition of Harbord's *Glossary of Navigation* published by Messrs. Griffin, of Portsmouth, may be of interest:

"A simpler form of the "Equation" is

$$E^s = \frac{1}{30} (\sec d \cot PXZ)\, dp''$$

where PXZ is the angle at the body contained by the circles of altitude and declination, sometimes called the "angle of position." In this case we have for sign the simple rule: "When the body's distance from the elevated pole is increasing add, when decreasing subtract." If PXZ is greater than 90° the rule is of course reversed, on account of the cotangent changing sign, but this can only occur when (1) latitude is less than declination and of same name and (2) when the observation is taken between the point of maximum azimuth and the meridian. For an observation taken at the maximum azimuth in such places the equation vanishes, a fact which is worth remembering, since at this instant, the Sun is moving in altitude most rapidly, and is therefore best suited for observation.

In a short treatise on "Types de Calculs" contributed by Captain Guyon of the French Navy to the "Annales Hydrographiques" for 1895, pub-

lished by the French Hydrographic Department, this form is adopted for the equation.

In a valuable work on Navigation by Mrs. Janet Taylor, an expression in one term is given as follows:

$$E = \cot h \operatorname{cosec} \theta \operatorname{cosec} \mathrm{p} \sin (\mathrm{p} - \theta)\, d\mathrm{p}$$

where $\tan \theta = \cot l \cos h$, with the same rule for signs as that given above.

The extract given above shows the position ten years ago, which has not changed materially at the present date.

PROFESSIONAL NOTES.

Prepared by Professor PHILIP R. ALGER, U. S. Navy.

SHIPS OF WAR, BUDGETS, AND PERSONNEL.

AUSTRIA.

VESSELS BUILDING.

Name.	Displacement.	Where Building.	Remarks.
Battleships.			
Erzherzog Ferdinand-Max.	10,600	Trieste.	Under trial.
Ersatz Tegetthof	14,500	—	Projected.
Ersatz Kr.-Rudolf	14,500	—	"
Ersatz Kr.-Stephanie	14,500	—	"
Scout.			
Ersatz Zara	3,500	—	Projected.

BRAZIL.

The Brazilian Government has placed orders for two battleships with Sir W. Armstrong, Whitworth & Co., who have sublet the building of one of them to Vickers, Sons & Maxim; also for two cruisers, to be built by Armstrong's and engined by Vickers. The battleships are to cost about £1,800,000 each, and the cruisers about £330,000 each. The main battery of the battleships is said to consist of four 13.5-inch guns.

FRANCE.

VESSELS BUILDING.

Name.	Displacement.	Where Building.	Remarks.
Battleships.			
Vérité	14,865	Bordeaux.	Under trial.
Liberté	14,865	St. Nazaire.	" "
Danton	18,350	Brest.	Building.
Mirabeau	18,350	Lorient.	"
Voltaire	18,350	Bordeaux.	"
Diderot	18,350	St. Nazaire.	"
Condorcet	18,350	"	"
Vergniaud	18,350	La Seyne.	"
Armored Cruisers.			
Ernest Rénan	13,644	St. Nazaire.	Launched April 9, 1908.
Jules Michelet	12,550	Lorient.	" Aug. 31, 1905.
Edgard Quinet	13,644	Brest.	" Sept. 21, 1907.
Waldeck-Rousseau	13,644	Lorient.	Building.

PROGRAMME FOR 1908.—The French naval programme for 1908 has been published. It is merely a continuation of the programme of 1906, and although the vessels in the list number 111, only 98 will really be in hand next year. The expenditure upon new constructions will be 104,267,606 francs, of which 90,173,000 francs are for hulls, armor, and torpedoes, and 14,094,606 francs for gunnery armaments. The vessels included in the programme are battleships, armored cruisers, destroyers, and submarines, protected cruisers having disappeared. Of the 98 vessels on the list six battle-

ships belong to the programme of 1906, and four armored cruisers, the *Ernest Rénan, Jules Michelet, Edgard Quinet*, and *Waldeck-Rousseau*, to that of 1900. In addition to these are 32 destroyers, of which seven at Rochefort and Toulon and 25 in private yards, and the list closes with 61 submarines or submersibles. In 1908 two armored cruisers, 12 destroyers, and 16 submarines are to be completed; 6 battleships, 2 armored cruisers, 10 destroyers, and 35 submarines to be continued, and 10 destroyers and 5 submarines to be put in hand. Four of the latter are of special types, designed by MM. Hutter, Radiguer, Bourdelle, and Maurice. They vary in displacement from 577 tons to 355 tons. Four of them are to have a maximum speed of 15 knots, and one of 15.8 knots. The larger vessels will have seven torpedo tubes, and all except the smallest will carry three officers and from 22 to 25 men.—*Army and Navy Gazette.*

PROGRAMME FOR 1909.—In view of the limited expenditure upon new vessels in the coming year, it was anticipated that the Minister of the Marine, by restricting his efforts to the six battleships of 18,350 tons now being built under last year's programme, was preparing for a much bigger development in the early future. The necessity for clearing off arrears and carrying out reforms in the arsenals and shipyards appeared sufficient to justify the small number of units which is to be put on the stocks during 1908, but a still more important factor in determining the Minister to postpone the final preparation of his programme is the uncertainty that has existed concerning the armament that should be carried on future battleships. While submarines, submersibles, and torpedo boats will continue to form an important part of the French Navy, it is obvious that so far as heavy units are concerned the Conseil Supérieur de la Marine intends to follow the lead of other nations by equipping the fleet with as many powerful battleships as possible. It is doubtful whether many, if any, armored cruisers will be included in the list of constructions for 1909, which seems likely to be almost entirely comprised of battleships of 20,000 to 21,000 tons. Fitted with turbine machinery, they are expected to have a speed of 20 knots. Before deciding upon the dimensions to be given to these new heavy units, the Conseil Supérieur de la Marine is now holding frequent sittings with a view to discussing the armament that will be carried. It appears that the Conseil has five proposals under consideration. The first is to equip the future battleship with 12 guns of 305 mm. bore; the second, to increase the number of these guns to 14; the third, to employ 16 guns of 274 mm. bore; the fourth, to have 20 guns of 240 mm. bore; and the fifth to adopt a compromise with 8 guns of 305 mm. and 8 of 240 mm. bore. There is apparently a strong feeling in favor of the third of these proposals—that is to say, adopting a numerous armament of 274 mm. guns—because it is argued that this type of ordnance is capable of proving very effective at a distance of 7000 m., which is regarded as the extreme fighting range. It is claimed that at a distance of 7000 m. the gun of 274 mm. bore will pierce armor 330 mm. thick under an incidence of 20 degrees. The advantage of having 16 guns of the same caliber is that a greater quantity of shells can be carried than would be the case if there were 305 mm. guns on board, while the number would permit of a concentrated firing which might prove very deadly at the maximum fighting range. All this depends, however, upon whether the future developments in the protection of battleships will not nullify the effect of shells from 274 mm. guns at the extreme fighting range. As it is expected that the Conseil Supérieur de la Marine will very shortly come to a final decision upon this question of armament, it will be interesting to see whether it has more faith in the guns or in defensive armor.—*Engineer.*

The estimated dates of the entry into service of French ships now building are for the *Danton* and *Mirabeau*, December, 1910, and for the other four of that class April, 1911. The *Edgard Quinet* and *Waldeck-Rousseau* are to be finished in 1910.

THE NEW BATTLESHIPS.—The Superior Council has fixed the following chief characteristics for the new battleships:

The main battery will be identical with that of the *Danton* class (four 12-inch and twelve 9.44-inch) and with the same arrangement, but a greater number of rounds per gun will be carried. The secondary battery will consist of eighteen 10-cm. and eight 47-mm. guns, and there will be four torpedo tubes. The main hull and turret protection will be the same as for the *Danton*, but there will be 10-cm. armor on the six casemates in which the 10-cm. guns are placed, and the smoke stacks, uptakes, and ventilators will be covered with 6-cm. armor as high as the upper deck. The torpedo protection of the *Danton* class will be suppressed, and Bullivant nets be relied upon instead. There will be the same coal supply as on the *Danton*, but the speed will be increased to 20 knots (instead of 19.25). These changes will increase the displacement to 21,000 tons (instead of 18,400) and make the price 60,000,000 francs.

THE EDGARD QUINET.—The armored cruiser *Edgard Quinet* was launched at Brest on September 21. She is 515 feet long, of 70 feet beam, and 14,000 tons (French) displacement. She will have 36,000 horsepower, giving at least 23 knots speed. Her armor consists of a 6¾-inch belt extending from 2.3 meters above to 1.4 meters below the water line, and of reduced thickness, but rising 5.2 meters above the water line forward. She has two armored decks, the upper from 0.8 inch to 1.3 inches thick and the lower from 2.6 inches to 1.8 inches thick, forming, with the belt, a caisson. Her guns are fourteen 7.7-inch, of which four are in two axial turrets, four in casemates and six in single turrets (the same arrangement as on the *Démocratie*); eighteen 65-mm. and eight 47-mm. guns. She will have six smokestacks and two masts, and will carry six 750-mm. searchlights. Her crew will consist of 750 men and 30 officers.—*Le Yacht.*

OIL FUEL FOR DESTROYERS.—One of the three new torpedo-boat destroyers of 450 tons and 28 knots speed has been ordered from the Forges et Chantiers de la Méditerranée at Havre, and another from the Chantier de St. Nazaire et Penhoët. They will carry six 9-pounder quick-firing guns, and three 18-inch torpedo tubes, and will be the first French destroyers to be fitted with oil fuel.—*Engineer.*

TRIALS OF FRENCH BATTLESHIPS DÉMOCRATIE AND JUSTICE.—These two battleships, which have recently finished their official trials, are the third and fourth of the 1900 programme, being sisters of the *République* and *Patrie*, described in our August number, and of the *Liberté* and *Vérité*, which are nearly completed. The ships have a load waterline length of 439 feet, an extreme beam of 79 feet 7 inches, and a draft of 27 feet 5 inches. The displacement is 14,867 tons, with a block coefficient of 0.543. An armor belt, with a maximum width of 18 feet 5 inches, has an extreme thickness of 11 inches, tapering to 3 inches at the ends. There are two protective decks.

The battery, which is a powerful one, consists in the first two of the type of four 12-inch guns mounted in pairs in two turrets, and eighteen 6.4-inch rapid-fire guns, of which twelve are in pairs in turrets and six are in casemates. The secondary battery includes twenty-seven 3-pounder and 1-pounder guns, and five torpedo tubes, two of which are submerged. A considerable difference exists in the battery of the last four ships of the type, through the substitution of ten 7.6-inch guns and eight 3.9-inch guns for the eighteen 6.4-inch guns on the first two vessels. This change makes for increased strength of broadside, particularly at long ranges. The 7.6-inch guns are located, six each in a single turret and four in casemates.

Each of the ships is propelled by three screws operated by triple expansion four-cylinder engines in separate watertight compartments. The

cylinder diameters are 35, 49, and 55 inches, with a stroke of 41½ inches. Steam is supplied by 24 watertube boilers, located in three boiler rooms, each with its own funnel. The total grate surface is 128 square meters (1378 square feet), with a heating surface of about 46,000 square feet, making a ratio of 33.4 to 1. The boiler pressure is 251 pounds per square inch. The normal coal supply of 900 tons gives an estimated steaming radius at 10 knots of 4200 nautical miles. With the full coal supply of 1850 tons, the estimated radius is increased to 8500 miles.

It must be pointed out that for the first time since the days of the old sailing fleet France possesses a homogeneous squadron of six vessels of high power, it having until recently been the French naval policy to construct contemporaneous vessels on the divergent designs of various naval architects, resulting in the acquisition of a fleet which was described by one of the French admirals as a "museum."

The first two ships of this type were compared in our August number with the battleship *Virginia*, of the United States Navy. The last four ships have a more powerful battery than the first two, but even with this advantage they could scarcely be expected to compete successfully with the ships of the *Virginia* class under ordinary conditions.

The results of the trials of the *Démocratie* and *Justice* are given in the table. The *Démocratie* is fitted with Belleville boilers, while the *Justice* has Niclausse generators. The poor propulsive efficiency at low speeds is more than offset by the magnificent results at 17 to 18 knots, while the figures for full speed are extremely good. It will be noted that, in passing from the intermediate to the highest speed, the index n in the expression $H_1 : H_2 :: V_1^n : V_2^n$ is very high, indicating a limit in highest propulsive efficiency at about 18 knots. This index, which is often assumed as 3, becomes 4.58 for the *Démocratie* and 5.98 for the *Justice*.

6-hour trial at low power.	Contract.	Démocratie.	Justice.
Boilers at work	5	5	5
Grate surface, square feet	287	287	287
Indicated horsepower	2,500	2,584	2,541
Consumption of coal in pounds:			
Per horsepower-hour		1.234	
Per square foot of grate			15.2
Mean speed in knots		7.5	7.8
Admiralty constant		98.8	112.8
Normal steaming radius		4,665	
24-hour consumption trial.			
Boilers at work		24	22
Grate surface, square feet		1,378	1,262
Indicated horsepower	10,500	11,472	11,520
Consumption of coal in pounds:			
Per horsepower-hour		1.484	1.528
Per square foot of grate			14.8
Average speed in knots		17.39	17.94
Admiralty constant		277.6	303.2
Normal steaming radius		2,027	2,023
Full power 3-hour trial.			
Boilers at work	24	24	24
Indicated horsepower	17,500	19,190	18,548
Consumption of coal in pounds:			
Per horsepower-hour			1.824
Per square foot of grate	24.3	24.3	23.7
Average speed in knots	18	19.44	19.43
Admiralty constant	201.6	231.6	239.1
Normal steaming radius			1,140

—*Nautical Gazette.*

NEW SUBMERSIBLES.—An order has been placed for 10 more submersibles of the *Pluviôse* type; they will be designated, for the moment, as 99-0 to 99-9, and will be built, two at Cherbourg, three at Rochefort, and five at Toulon. This order is proof that this type, the first of which have but recently begun their trials, is regarded as a satisfactory one.

GERMANY.

VESSELS BUILDING.

Name.	Displacement.	Where Building.	Remarks.
Battleships.			
Schleswig-Holstein ..	13,200	Kiel.	Launched Dec. 17, 1906.
Schlesien.....	13,200	Danzig.	" May 28, 1906.
Ersatz Bayern	19,000	Wilhelmshaven.	Building.
" Sachsen	19,000	Bremen.	"
" Würtemberg .	19,000	Stettin.	"
" Baden	19,000	Kiel.	"
Armored Cruisers.			
Gneisenau	11,600	Bremen.	Launched June 14, 1906.
Scharnhorst.....	11,600	Hamburg.	Under trial.
E	15,000	Kiel.	Building.
F.	18,000?	Hamburg.	"
Protected Cruisers.			
Stuttgart	3,420	Danzig.	Under trial.
Stettin.....	3,420	Stettin.	"
Nürnberg	3,420	Kiel.	"
Ersatz Pfeil.....	3,800	"	Building.
Dresden	3,800	Hamburg.	Launched Oct. 5, 1907.
Ersatz Greif.....	4,300	Danzig.	Building.
" Jagd	4,300	Stettin.	"

BUILDING PROGRAMME.—The battleships which are to follow the four 19,000-ton ships now building will be the *Ersatz Oldenburg* and *Ersatz Siegfried*, to be begun in 1908, and the *Ersatz Beowulf* and *Ersatz Frithjof*, to be begun in 1909. The *Ersatz Kaiserin-Augusta*, *Ersatz Hertha* and *Ersatz Victoria-Luise* are to follow, being begun in 1910, 1911, and 1912, respectively.

Of the six armored cruisers voted in 1906, the four remaining are to be begun in 1909, 1910, 1911, and 1912, respectively. Cruisers *E* and *F* are the two first of the six.—*Le Yacht.*

ADDITIONS TO THE FLEET.—On October 1 the *Pommern* replaced the *Kaiser Frederick William*, the *Hanover* replaced the *Brandenburg*, and the *Kaiser Barbarossa* replaced the *Kaiser Frederick III* in the fleet. The *Pommern* attained a maximum speed of 19.26 knots, with 20,348 horsepower, on her trials, a record ahead of that of any other German battleship, and nearly equal to that of the French *Liberté;* her coal consumption, however, is said to have been very much higher than that of the *Liberté.*

The *Kaiser Barbarossa* has undergone the work of reconstruction, which is to be applied to all the battleships of that class. This consists of removing portions of the superstructures as well as the four 6-inch guns of the lower casemates, leaving them armed with four 9.5-inch guns and fourteen 6-inch guns, and raising their armor belts somewhat.

ARMORED CRUISER F.—The new large German cruiser *F*, the contract for which has been placed with the Hamburg firm of Blohm & Voss, will cost over £1,800,000, and will be fitted with Parsons turbines, which are to be constructed by the same firm. The cruiser *E*, which was laid down in the navy yard at Kiel a year ago, will have a displacement of about 15,000 tons, but, as the cost already shows, the new cruiser is designed to be considerably larger. The gradual conversion of the German naval authorities to the turbine system of engines is further shown by the fact that the two small cruisers which are to be laid down by the Schichau and Vulcan com-

panies this year are also to be fitted with this type of engine. The small cruiser *Stettin*, the newest of her class afloat, which is also propelled by turbines, developed a speed of 25.8 knots on her trials a few days ago. It is believed that for the present tactical considerations forbid the adoption of the system for battleships, but according to various statements in the Press, it is not unlikely that before long efforts will be made to create a homogeneous squadron fitted with these engines.—*Army and Navy Gazette.*

Cruiser *F*, which is the first real continental reply to the British *Inflexible* class, has just been definitely ordered from Messrs. Blohm and Voss, of Hamburg, who have recently completed a splendid new machine shop for the construction of marine turbines. This vessel is to be completed within two years from now. Her designed displacement is practically 20,000 tons, and her speed of 24½ knots will require about 44,000 indicated horsepower, which will be provided by turbines of the Parsons type. Exceptional care is being taken to keep the details of construction confidential; the main dimensions, however, appear to be as follows: Length on water line, 560 feet; beam, 85 feet; draft, 27 feet.

Two small cruisers of 4300 tons have also been ordered from the Vulcan yard at Stettin and from Messrs. Schichau, at Danzig. The former will be fitted with a modified form of Curtis turbine supplied by the Allgemeine Elektrizitäts Gesellschaft, and the latter with turbines of the type introduced by Melms and Pfenniger. The latter turbine is a modified Parsons, embracing many features of the Westinghouse combination system. The Krupp Germania works are also reported to have the order for a similar vessel which is to be fitted with Zoelly turbines. The speed in the case of these small cruisers is to be 25.5 knots.—*Engineer.*

The German Navy League does not appear to be so satisfied with its Admiralty as is the British one. It is just conducting a strong agitation in favor of ships of 22,000 tons and 12-inch guns instead of 11-inch. Recent report has had it that the *Ersatz Sachsen* class are to carry two 12-inch per turret, instead of the original three 11-inch. The Navy League agitation suggests that the matter is still undetermined—a thing that should be useful powder to those of our contemporaries which expend so much energy in proving that the new German battleships do not yet exist.—*Engineer.*

The *Lokal Anzeiger* says that the new naval programme will include a proposition to decrease the nominal life time of battleships from 25 to 20 years of active service; this project, if carried, will lead to the construction of five 19,000-ton battleships instead of only four.

TURBINE CRUISER DRESDEN.—The *Ersatz Komet*, now named *Dresden*, was launched at Hamburg on October 5. She is a sister ship to the *Ersatz Pfeil*, is of 3800 tons displacement; 118 meters by 13.5 meters by 4.8 meters draft; armed with ten 4-inch and eight 2-inch guns, and two torpedo tubes; and is designed for 13,700 horsepower, giving a speed of 24.5 knots.—*Moniteur de la Flotte.*

THE STETTIN.—The *Stettin*, sister ship to the *Nürnberg* and *Stuttgart*, but equipped with the Parsons turbine, attained a mean speed of 25.8 knots for six hours on 3200 tons displacement. From this it is judged that she will make at least 25 knots on her contract displacement of 3400 tons. —*Moniteur de la Flotte.*

PERSONNEL.—Vice-Admiral Fischel, commanding the second squadron, has been made admiral; he is one of the best-known leaders in the German Navy, and is likely to soon be given command of the sea-going fleet.

Vice-Admiral Schmidt has been called to the general direction of the

Navy Department; Vice-Admiral Breusing to the command of the arsenal of Wilhelmshaven; hitherto these places have been held by rear-admirals.

An important change, which will perhaps have considerable results, is the relief of Vice-Admiral Eickstedt, by Rear-Admiral Rollman as director of the Department of Naval Construction. The former has filled this office for more than eight years, ever since the death of Chief Constructor Diétrich since which time there has been no chief constructor in the German Navy.

There are now 4 admirals, 10 vice-admirals, and 22 rear-admirals in the German Navy, of whom the senior, Admiral Tirpitz, entered the service in 1865.—*Moniteur de la Flotte.*

SMALL CRUISERS.—The *Koenigsberg*, which replaced the *Medusa* in the German fleet, on September 15, is the connecting link between the seven small cruisers of the *Bremen* class, of 3250 tons, and the three cruisers of *the Nürnberg* class (*Stuttgart, Stettin*, and *Nürnberg*), of 3450 tons, though she is much nearer the latter than the former class, having attained 24.1 knots speed on her trials. The distinction between these ships is, however, but slight, the *Nürnbergs* and *Bremens* having practically the same outline, the main battery of all being ten 4-inch guns, and the speed in each case the highest attainable at the date of laying down. Still, as we shall see, while keeping the same armament and practically the same profile, the eight types of small cruiser which have succeeded one another from 1897, when the *Gazelle* was begun at Kiel, to the present time when the *Ersatz Greif* and *Ersatz Jagd*, of the 1907-1908 programme, are building, have almost doubled in displacement. The *Gazelle* was of 2645 tons, the *Ersatz Greif* will exceed 4000 tons. To some small extent this increase has profited the armament; since the *Ersatz Pfeil* and *Ersatz Komet* will have, besides the ten 4-inch guns of 50 calibers, eight 2-inch guns, instead of the ten 37-mm. guns of the preceding types, but the protection remains unchanged, consisting of a deck from 50 mm. to 20 mm. thick and a conning-tower from 76 to 100 mm. thick. In the main the increased displacement has been used to increase speed and radius of action.

The speed of the *Gazelle* was 19.5 knots; that of the *Frauenlob* (1900) was 21.5 knots; of the *Bremen* (1902), 23.2 knots; it exceeded 24 knots with the *Koenigsberg* (1904); and should be 24.5 knots with the *Ersatz Pfeil* (1906) and over 25 knots with the *Ersatz Greif* (1907). If now we examine the linear dimensions, we find that length and beam alone have increased. The draft of the *Gazelle*, which was 4.85 meters, is found unchanged on the latest types, though it is true that the *Frauenlobs* and *Bremens* were exceptions in drawing 5 meters.

The radius of action of the *Gazelle* is 4000 miles, with 560 tons of coal; 700 tons give 4500 miles to the *Frauenlob;* the *Bremens* carry 800 tons and can steam 5000 miles, and the *Koenigsberg* is the same; the *Nünbergs*, with 850 tons, should have 5500 miles radius; and the latest types will probably do still better.

That the increase of displacement comes from increase of length and beam, the following figures show: The *Gazelle* is 100 meters long and of 11.8 meters beam; the *Frauenlobs* are 100 meters by 12.3 meters; the *Bremens* 104 meters by 13.2 meters; the *Nürnbergs* 108 meters by 13.4 meters; and, finally, with the *Ersatz Pfeil* we come to 118 meters length, 13.5 meters beam, and 4.8 meters draft.

These small cruisers are not only excellent scouts, but well suited for foreign service—more powerful and seaworthy than the English scouts, they have no equivalent in any other navy.

GERMAN TORPEDO BOAT CONSTRUCTION.—The steady addition of torpedo craft of large size to the Imperial German Navy continues unchecked, and their value for war purposes is somewhat disguised by the official system of frequently describing them as torpedo boats, instead of classing them,

as would be the case in England, as "destroyers." In general, their torpedo equipment is greater than that of British vessels of corresponding date, while their guns are fewer and less powerful; their hulls are of relatively heavier scantlings, and the vessels themselves have proved to be excellent sea boats, though slightly inferior in trial-trip speed to those of other nations.

No less than 22 boats of about 420 tons service displacement—*G110* to *G113*, and *S114* to *S131*—were constructed by Messrs. Krupp, at the Germania Works, and by Schichau, at Elbing, between 1902 and 1905. Differing only slightly in detail, they are all about 205 feet long by 23 feet beam, and have bunker capacity for 100 tons of coal; at 15 knots the service radius of action is about 1400 miles. Their trials were run at displacements varying from 380 to 415 tons, and speeds between 27 and 28 knots were obtained with about 6000 to 6500 indicated horsepower. *S125* of the latter division, built by Schichau, was the first vessel in the German Navy fitted with Parsons' turbines. On her official trials she attained 26.7 knots at 440 tons, the increase in displacement being due to the greater amount of coal on board compared with her sister ships. The armament consists of three 4-pounder quick-firing guns, two machine guns, and three 450-mm. torpedo tubes. Comparing these with British practice, we find that during the same period 35 *River* class destroyers of 570 tons were added to the Royal Navy, each carrying one 12-pounder and five 6-pounder quick-firing guns, but only two tubes. Their average full speed was barely 26.0 knots, but on their greater dimensions—225 feet in length by 23 feet 6 inches beam—they carry 125 tons of coal, and their radius at 15 knots is nearly 1800 miles.

The next batch of German boats—*G132-G136*—was ordered in 1905, and consisted of 460-ton boats of 28 knots speed, carrying, as usual, three torpedo tubes, as well as four 5-pounder quick-firing guns and two machine guns. All these vessels were launched in 1906, and are now either in service or being completed at the Germania Works. They are almost identical with the previous destroyers, and, being built by only two firms, present fewer divergencies of appearance than is the case with the various British boats—Laird's and Palmer's, for example.

Since the commencement of 1907 several 30-knot boats, ordered in 1906, have been launched or have run their trials. *G137* really belongs to this class, though she was ordered in December, 1905; the others consist of the Schichau division, *S138-S149*. These vessels all carry one 15-pounder, three 5-pounders, two machine guns, and three torpedo tubes. The designed displacement was 570 tons in the case of *G137*, and 530 for the other boats; the indicated horsepower was to be 10,000. Four Schulz boilers are fitted, as against three in the earlier boats, the pressure being 230 pounds per square inch. In point of size they closely approach the dimensions of the *River* class, but are about 10 feet longer and 1 foot wider. About eight of the *S* class have run their trials, and, at a reduced displacement, have only attained 29.6 knots, though the horsepowers ran up to nearly 11,000. Considerable difficulty was involved in reaching even this speed, and numerous propellers were tried without success. The remainder of this batch is now approaching completion.

The latest destroyer division to be built for the German Navy was ordered early this year from the Vulkan Company, which was entrusted with torpedo-boat work for the first time, and consists of twelve 580-ton boats *V150* to *V161*. Like *G137* they are 235 feet long by 24.10 beam, and carry the same armament. As in most of the German destroyers, the engines are placed in two compartments, one abaft the other, and the coal bunkers, of 115 tons capacity, are extended at the sides of the engine-room for purposes of protection. The designed speed is 30 knots, and in view of the performance of *G137*, it will be interesting to see how these vessels compare with her. At present they are approaching the launching stage.

G137 is fitted with marine turbines of the Parsons type, and on her re-

cent official trials on the German Admiralty mile at Neukrug, attained a maximum speed of nearly 34 knots, and a mean speed for four hours of 33.1 knots, the vessel being run at full load. This performance makes her, for the time being, the fastest vessel afloat, and, following on the failure of the sister ships of the *S138* class to attain their designed speed, has created considerable interest in German naval circles where the turbine has hitherto been greatly disparaged. The main turbines consist of one high-pressure and two low-pressure cylinders of the usual type, arranged on three shafts, and revolve at about 850 revolutions per minute. Running astern, a speed of over 16 knots was obtained. The coal consumption averaged about 12 tons per hour at full speed.

No vessels corresponding to the large British destroyers of the *Cossack* type are as yet under construction, though it is possible that they may figure in the next naval estimates. For such speeds and displacements—33 knots and 780 tons—it is probable that oil fuel will be found essential, and this has not yet been applied to German torpedo craft.—*Engineer.*

The Ministry of Marine have given orders that a third destroyer, one of the group *V150-V161*, under construction at the Vulcan yard, Stettin, is to be fitted with turbine engines on the Curtis system. The first boat to be fitted with turbines was *S125*, one of a group built in 1904, by the Schichau firm at Elbing, which had a displacement of 470 tons, and a speed of 28.5 knots, her turbines were on the Parsons system. The second, also fitted with Parsons turbines, is *G137*, built at the Germania yard, Kiel; she has a displacement of 570 tons, and at her recent official trials attained a speed of over 32 knots, or more than two knots over the contract speed. She will probably form the model for a division of similar vessels—*United Service Institution.*

GREAT BRITAIN.

VESSELS BUILDING.

Name.	Displacement.	Where Building.	Remarks.
Battleships.			
Bellerophon	18,600	Portsmouth.	Launched July 27, 1907.
Téméraire	18,600	Devonport.	" Aug. 24, 1907.
Superb	18,600	Newcastle.	" Nov. 7, 1907
St. Vincent	19,250	Portsmouth.	Building.
Collingwood	19,250	Devonport.	"
Rodney	19,250		Authorized.
Armored Cruisers.			
Minotaur	14,600	Devonport.	Launched June 6, 1906.
Shannon	14,600	Chatham.	" Sept. 20, 1906.
Defence	14,600	Pembroke.	" Apr. 27, 1907.
Invincible	17,250	Newcastle.	" Apr. 13, 1907.
Inflexible	17,250	Clydebank.	" June 26, 1907.
Indomitable	17,250	Glasgow.	" Mar. 16, 1907.
Cruiser.			
Boadicea	3,300	Pembroke.	Building.

NEW BATTLESHIPS.—The battleships of the improved *Dreadnought* type about to be laid down at Portsmouth and Devonport dockyards, and a third by private contract, are officially to be known as the *St. Vincent* class. The particulars sent out by the Admiralty state that their length between perpendiculars will be 500 feet, the beam 84 feet, and the displacement 19,250 tons. It is added that the primary armament will be 12-inch guns, but the number is not stated. Compared with the *Bellerophon*, *Téméraire*, and *Superb*, the new ships will be 10 feet longer and of 650 tons more displacement.—*United Service Gazette.*

The new battleship of the 1907-8 programme, being built at Portsmouth, will be named *St. Vincent;* the one at Devonport, the *Collingwood.* The

third battleship to be built by contract will, it is rumored, be called *Rodney*—at any rate, one of the class will.

The battleships that may follow are provisionally intended to be of the same class, and the names *Benbow, Camperdown, Anson,* and *Howe* are gradually to be used up for them.—*Engineer.*

The report that the *St. Vincents* were to have 13.5-inch guns seems to be without warrant, and it is almost certain that they are to be armed with ten 12-inch guns in five turrets, all probably on the middle line. It is now said that the 13.5-inch guns are really intended for the two Brazilian battleships building in England.

The *Superb,* launched at Elswick, on Nov. 7, was laid down on February 6 last, and will be completed for service by the spring of 1909.

The *Superb*—like the *Bellerophon* and the *Téméraire*—is a little larger than the *Dreadnought.* Her dimensions are: Length, 490 feet; beam, 82 feet; draft, 27 feet; displacement, 18,600 tons. She is thus of the same length and beam as the *Dreadnought* (and will have the same speed, 21 knots), but has 700 tons more displacement and 6 inches greater draft.

The armament will consist of ten 12-inch guns, together with a number of 4-inch quick-firers for use in resisting attacks by torpedo craft. The main armor belt has a maximum thickness of 11 inches, tapering to 6 inches at the forward and 4 inches at the after extremity of the vessel. Special attention has been given to safeguarding the ship from destruction by under-water explosion.—*Page's Weekly.*

H. M. S. GHURKA.—The torpedo-boat destroyer *Ghurka* has recently been completed by Messrs. Hawthorn, Leslie & Co., Limited, of Hebburn-on-Tyne, and will shortly undergo her official trials. The *Ghurka* is 255 feet in length by 25 feet 6 inches in width, and 16 feet 6 inches in depth amidships. She is fitted with turbine engines, built under Messrs. Parsons' patent, arranged on three shafts and developing between 14,000 and 15,000 horsepower in the aggregate. There is one high-pressure turbine on the center shaft exhausting into two low-pressure turbines on the wing shafts, the astern turbines being incorporated with the latter. Ahead of the low-pressure turbines on the wing shafts is a high-pressure and low-pressure cruising turbine, each turbine driving a shaft with one propeller. Steam is supplied by five water-tube boilers of the latest Yarrow type, working at a pressure of 220 pounds per square inch, and fired with oil fuel. The only coal carried on the vessel is that for heating and cooking purposes. The whole of the machinery, which is arranged for forced lubrication, is interchangeable with the sister vessels, the contracts for the construction of which were placed by the Admiralty with Thornycroft & Co.; White & Co.; Cammell, Laird & Co., and Armstrong, Whitworth & Co. The *Ghurka* is armed with three 12-pounder quick-firing guns, two being placed on the forecastle and one aft, whilst she will also have two deck torpedo tubes.

In preliminary trials the vessel attained the speed of over 33 knots, and after certain minor modifications are carried out it is believed that this speed will be substantially increased.

The Laird-built destroyer *Cossack* is completing her official trials on the clyde. On her full speed trial she averaged 33.141 knots, and, like all of her class, was displacing considerably more than was originally intended.—*Engineer.*

SEA-GOING TORPEDO-BOATS.—The *Eden* is one of 34 sister vessels launched for the British government between 1903 and 1905. As a class, they are from 220 to 225 feet in length, 23½ feet beam, and draw 10 feet of water. There are slight variations among the 34 vessels as to dimensions and general particulars, the *Eden* being 220 feet long, 23 feet beam, and 8¾

feet draft. She is driven by Parsons turbines, operating six propellers, and with 7000 horsepower her mean speed is 25½ knots an hour. She carries one 12-pounder gun forward and five 6-pounders aft and in broadside. She has two torpedo tubes, a coal capacity of 130 tons, and a complement of 70 officers and men.

Now in the *Eden* class of boats, the high speed of the preceding class of seventy 30-knot boats, built between 1896 and 1902 for the British Navy, has been sacrificed in favor of seaworthiness, comfort, and coal capacity. The 30-knot boats were about 10 feet shorter, of from 2 to 3 feet less beam, and about 4 feet less draft, and their displacement was 300 tons as compared with the 550 tons displacement of the *Eden* class. The *Eden* carries a high forecastle deck, which extends aft to the conning-tower, and it is upon this deck that the 12-pounder gun is mounted. She has a rather lofty bridge, a single signal mast, and two low funnels of large diameter. The other vessels of the class are generally similar in design, the main difference being that 15 of the boats are provided with four funnels instead of two.

In the later ships, authorized from 1905 to 1906, the tendency to increase the displacement is even more marked, but at the same time there is a return to the high speed of the boats of the 1896 to 1902 period. Under this programme there are now being built five ocean-going turbine-driven torpedo-boats of 600 tons displacement and 33 knots speed, and one turbine-driven ocean-going torpedo-boat of 800 tons displacement, 30,000 horsepower, and 36 knots speed.—*Scientific American.*

The *Agamemnon* has finished her steam trials. She made 18.75 knots at full power, with 17,285 horsepower and 130 revolutions; the coal consumption being 2.11 pounds per horsepower per hour.

The cruiser *Blenheim*, which was launched 15 years ago, has been transformed into a sea-going depot ship for torpedo craft. Equipped originally with two 9.2 and ten 6-inch breech-loading guns, her armament is now reduced to four 6-inch guns, and her auxiliary armament of 16 quick-firing guns has been reduced to 10 small quick-firing guns. Extensive alterations have been made in the *Blenheim* to enable her to carry, in addition to her own complement of 670 tons of coal, 9400 cwt. of coal in 1 cwt. sacks for the use of destroyers. She will serve with the active service flotillas in the North Sea.—*United Service Gazette.*

H. M. S. *Dreadnought*, which is having new steering gear fitted at Portsmouth, is shortly to be placed in dock to have her propeller blades changed. —*Page's Weekly.*

It is reported that the *Dreadnought's* new propellor blades are 12 inches longer and 7 inches wider than her old ones.

MECHANICAL STOKING.—A series of interesting experiments is being carried out on board the gunboat *Sharpshooter* at Devonport, with the object of proving the possibility of the application of mechanical stoking to marine boilers. On land it has been demonstrated that the employment of a revolving grate with automatic feed, supplies all that is needed in the systematic and careful stoking of water-tube boilers. Want of space in the smaller vessels such as torpedo-boats, however, has precluded the adoption of this appliance on ships. The device, which is now under trial, comprises a set of hoppers with mechanism for regulating the supply and depth of fuel, and a small engine geared to an eccentric and piston which keeps the firebars in continual motion. The movement of the bars is from front to rear and return, the travel being about 18 inches each way.—*United Service Gazette.*

A YEAR'S CASUALTIES TO WARSHIPS.—A return of casualties to ships on the Navy List during the year ended December 31, 1906, has been issued as a parliamentary paper. The casualties include all cases of collision or grounding, and casualties to machinery, and the return shows the date, the name, and class of the ship damaged, the nature of the accident, time under repair, and the result of any inquiry that may have been held into the circumstances, specifying if a court-martial was held. The number of casualties, including those which happened to destroyers, submarines, special service vessels, and other small craft was 74, and the casualties to machinery nine. Of the above casualties 14 happened to battleships, 15 to cruisers, 23 to destroyers, 14 to torpedo-boats, and the remainder to other classes of vessels.

The mishaps to the battleships include such as the flooding of an engine-room owing to a valve being left open, which happened in the *Cornwallis*, several collisions, the mishap to the *Dreadnought*, which struck the sill when being put into dock, and the loss of the *Montagu*. Only in the last-named case was there a court-martial. In several of the cases no blame was attributable to the officers, and in others those responsible and held to blame were punished. In respect of the cruisers the nature of the casualty varies very widely, and only one court-martial was held, in the case of the *Donegal*, while in the majority of cases it was reported after inquiry that no blame was attributable to the officers in charge of the ship.

Only one other court-martial was held, in the case of the loss of a torpedo-boat, while in tow of the *Arrogant*. Very many of the mishaps were of a trivial character, and even such an accident as the capsizing of the pinnace of the *Hindustan* is included in the list. The longest time during which a vessel was under repair occurred in the case of the destroyer *Thrasher*, which, after grounding at Bantry, was 21½ weeks in the dockyard hands, during which time she was given a general refit. None of the casualties to machinery were of a serious nature.—*United Service Gazette.*

HEALTH OF THE NAVY FOR 1905.—The returns for the total force for the year 1905 may be considered as very satisfactory. As compared with the averages of the last eight years, there are decreases in the ratios of cases, invalidings and deaths, and this year's case and death ratios are the lowest recorded since 1856.

There have been considerable changes in several of the stations, hence comparisons with the returns of former years from these stations would be misleading.

A comparison with the average for the last eight years is instituted when possible.

The ratio of cases per 1000 of force shows a reduction of 119.29 as compared with the last eight years' ratio.

The invaliding ratio, viz., 23.89 per 1000, shows a decrease of 4.98 in comparison with the average for the last eight years.

As regards the death rate, the ratio per 1000 was 3.9, showing a decrease of 1.42 when compared with the last eight years' ratio.

The Mediterranean station shows the highest invaliding ratio, the East Indies the highest death rate.

No cases of yellow fever or plague, and only two cases of small-pox are returned.

Venereal diseases show a small decline as compared with the last eight years' ratio.

One man was invalided out of the Service for wounds in action sustained in 1904.

The total force, corrected for time, in the year 1905, was 111,020, and the total number of cases of disease and injury entered on the sick list was 81,568, which is in the ratio of 734.71 uper 1000, being a decrease of 119.29 per 1000 as compared with the average ratio of the last eight years.

The average number of men sick daily was 3,365.53, giving a ratio of

30.31 per 1000, and showing a decrease of 5.44 in comparison with the last eight years' average. The total days' sickness on board ship and in hospital was 1,228,419, which represents an average loss of service from disease and injury of 11.06 days for each person, which is a decrease of 1.99 in comparison with the average of the last eight years.

The total number of persons invalided was 2653, which is in the ratio of 23.89 per 1000, and shows a decrease of 4.98 in comparison with the average of the last eight years. Of the above total 1719 persons were finally invalided from the Service (121 of these refused surgical operation), giving a ratio of 15.48 per 1000 for the whole force, or 64.79 per cent of the number invalided, thus showing a decrease of .4 per 1000 when contrasted with 1904.

Including the marines invalided at headquarters, the total number invalided out of the Service was 1941. It should be noted that the invalids from marine headquarters appear for the first time in this table.

Deaths number 433, a ratio of 3.9 per 1000—showing a decrease of 1.42 per 1000 as compared with the ratio for last eight years.

The average number of entries on the sick list for disease and injury per man was: On the Home station, .68; Channel, .65; Atlantic, .78; Mediterranean, .71; North America and West Indies with particular service squadron, .89; China, .85; East Indies, .83; Australia, .7; Cape of Good Hope, .93, and the Irregular Force, .92. In the total force the average per man was .73, a decrease of .02 in comparison with 1904.

The total number of persons invalided was 2653, of whom 2445 were invalided for disease and 208 for injury. The ratio of invaliding for disease alone was 22.02, and for injury 1.87, per 1000.

The total number of deaths was 443, of which 305 were from disease and 128 from injuries. The death rate due to disease alone was 2.74 and that due to injuries was 1.15 per 1000.—*United Service Institution.*

ITALY.

VESSELS BUILDING.

Name.	Displacement.	Where Building.	Remarks.
Battleships.			
Roma	12,625	Gov't Yard, Spezia.	Launched Apr. 21, 1907.
Napoli	12,625	" " Naples.	" Sept. 10, 1905.
Vittorio Emanuele	12,625	" " Castellamare.	" Oct. 1, 1904.
Armored Cruisers.			
San Giorgio	10,200	Gov't Yard, Castellamare.	Building.
San Marco	10,200	" "	"
Pisa	10,200	Orlando Works.	Launched, Sept. 15, 1907.
Amalfi	10,200	Odero Works.	Building.
B	10,200	Leghorn.	"

THE SAN GIORGIO CLASS.—The *Pisa* was launched at Leghorn, on September 15. She is a sister ship to the *San Giorgio, San Marco, Amalfi,* and a fifth ship (*B*) also building at Leghorn. These ships are of 10,200 tons displacement, and carry four 10-inch and eight 7.5-inch guns, in double turrets, together with sixteen 3-inch guns and three torpedo tubes (450 m.), two broadside and one stern. Special chrome steel was largely used in the hull construction of the *Pisa.* She is to have a speed of 23 knots, and is to carry 1600 tons of coal, giving a radius of action of 10,000 knots. She has a complete armor belt, of Krupp armor, 8 inches thick at the center and tapering to 4 inches at bow and stern.

The *Moniteur de la Flotte* states that the Italian Government has purchased the *Pisa* and *Amalfi.*

According to *Le Yacht,* the Superior Council has approved the expenditure of 200 million francs for four battleships of great displacement.

JAPAN.

VESSELS BUILDING.

Name.	Displacement.	Where Building.	Remarks.
Battleships.			
Satsuma.....	19,200	Yokosuka.	Launched Nov. 15, 1906.
Aki.....	19,800	Kure.	" Apr. 15, 1907.
Armored Cruisers.			
Ibuki.....	14,600	Kure.	Launched Nov. 21, 1907.
Kurama.....	14,600	Yokosuka.	" Oct. 21, 1907.
Protected Cruiser.			
Tone.....	4,100	Sassebo.	Building.
Scouts.			
Yodo	1,850	Kobe.	Building.
Mogami.....	1,350	"	"

THE KURAMA.—On October 21 the *Kurama* was launched at Yokosuka. She and the *Ibuki* are like their predecessors, the *Tsukuba* and *Ikoma*, except that they are said to be slightly larger. The *London Times* gives the displacement of the *Kurama* at 14,800 tons and her battery as four 12-inch, eight 8-inch, and twelve 6-inch guns, besides a number of small R. F. guns. Her anticipated speed is 22 knots.

AN 1100-TON DESTROYER.—Japan is building the biggest and fastest torpedo-boat destroyer in the world. The craft will have a tonnage of 1100 and a speed of 35 knots. The armament will be one 5-inch and eight 4-inch guns, and she will have four torpedo tubes. It is intended that she shall be able to accompany battleships in any weather.—*Nautical Gazette.*

Le Yacht states that the 1100-ton destroyer above referred to has been laid down at Maitzuru, but gives her battery as one 4-inch and several 3-inch guns, with four torpedo tubes.

The *Iwami*, ex *Orel*, which is being reconstructed in Japan, has had her secondary armament altered—six 8-inch being substituted for the twelve 6-inch that she formerly carried. The reason of the change is that the Japanese—like some others—have found these double turrets quite unsatisfactory. The rate of fire of a pair of 6-inch is very little more than for a single 6-inch gun. Several of the turrets being badly damaged had to be replaced. Advantage was taken of this to make a clean sweep of the old secondary armament.—*Engineer.*

The personnel of the Japanese Navy has just been returned at 40,044.

WARSHIP BUILDING IN JAPAN.—During the past decade or so Japan has made great progress in the building of warships. The naval shipbuilding yards at Yokosuka and Kure are now able to construct battleships and armored cruisers of the latest type, such as the *Satsuma, Aki, Tsukuba, Ikoma, Kurama,* and *Ibuki,* with tonnage between 13,000 and 20,000 tons. Of these, the third—namely, the *Tsukuba*—is the finest ship ever built in Japan, being furnished with excellent machinery and everything necessary for the highest efficiency. She is at present on a voyage round the world, and she has been very successful in every respect. The plans of two new sister-ships, each of 20,000 tons, are said to have been completed, and it is expected that before long their keels will be laid at Yokosuka and Kure. An ample supply of good steel can now be obtained in Japan, and only a few of the materials which cannot yet be made in Japan have to be ordered from abroad. Since 1875, when the gunboat *Seiki* was launched at Yokosuka, the number of warships built in Japan totals 38 (destroyers and torpedo craft excluded), their tonnage aggregating 184,588 tons.—*Engineering*

Le Yacht gives the following particulars regarding Japanese ships: "The *Aki* has a battery of four 12-inch, twelve 10-inch, and twelve 4.7-inch guns, on a displacement of 19,250 tons. The four battleships proposed to be begun next year are to be of 21,000 tons and to carry twelve 12-inch and ten 6-inch guns each. The speed of all these ships is to be 20 knots."

RUSSIA.

VESSELS BUILDING.

Name.	Displacement.	Where Building.	Remarks.
Battleships.			
Emperor Paul I	16,900	St. Petersburg.	Launched Sept., 1907.
Andrei Pervozvannui	16,900	"	" Oct. 20, 1906.
Evstafi	12,500	Nicolaiev.	" Oct. 1906.
Ivan Zlatoust	12,500	Sevastopol.	" May 13, 1906.
Armored Cruisers.			
Admiral Makaroff	7,800	La Seyne.	Under trial.
Bayan	7,800	St. Petersburg.	Launched Aug. 15, 1907.
Pallada	7,800	"	" Nov. 10, 1906.
Rurik	15,000	Vickers.	Under trial.
Protected Cruiser.			
Outchakoff	6,750	Sevastopol.	Building.

THE EMPEROR PAUL I.—The launch has just taken place at St. Petersburg of the Russian ironclad *Imperator Pavel-Perrvy*. The vessel has a displacement of 16,900 tons, and she is 460 feet long by 81 feet 4 inches beam. Her engines work up to 17,600 horsepower; they drive two screws, and are expected to give her a speed of 18 knots per hour. She will carry 3000 tons of coal, which will enable her to steam 6000 miles at 12 knots. She will carry 62 guns and 8 Maxim mitrailleuses; she will also be fitted with six lance torpedo tubes. The *Imperator Pavel-Perrvy* resembles the *Czarevitch*, built in France by the Forges et Chantier de la Mediterranée, but she is a larger ship.—*Engineering*.

NEW SHIPS.—The two battleships to be begun this year will be given to the new Admiralty Works and the Baltic Works, respectively. They will be of 19,900 tons, carry ten 12-inch guns, and have 21 knots speed with turbine machinery. Their armor and armament will be made in Russia.

Two 4500-ton cruisers, of the *Variag* type, but with a light armor belt, have been ordered from the Newski Works; they are to be finished in three years.

UNITED STATES.

VESSELS BUILDING.

No.	Name.	Speed. Knots.	Where Building.	% of Completion Nov. 1, 1907.
	Battleships.			
23	Mississippi	17	Wm. Cramp & Sons.	96.8
24	Idaho	17	Wm. Cramp & Sons.	89.4
25	New Hampshire	18	New York Shipbl'g Co.	90.2
26	South Carolina	18.5	Wm. Cramp & Sons.	28.8
27	Michigan	18.5	New York Shipbl'g Co.	29.1
28	Delaware	21	Newport News.	2.3
29	North Dakota	21	Fore River.	4.2
	Armored Cruisers.			
12	North Carolina	22	Newport News.	93.3
13	Montana	22	Newport News.	87.4
	Scout Cruisers.			
	Chester		Bath Iron Works.	92.7
	Birmingham		Fore River Shipb'g Co.	90.8
	Salem		Fore River Shipb'g Co	88.5

THE PROGRESS OF THE SUBMARINE BOAT. (A review of the results of the tests recently carried out by the United States Navy Department).—The recent announcement that an order had been placed by the United States Navy Department for seven submarine boats of the *Octopus* type recalls the elaborate and searching tests made in the early summer of the present year to determine the best available type of submarine boat for the proposed extension of this arm of the navy. Three designs were submitted to the board: the *Octopus* of the well-known Holland type, a boat of 273 tons displacement, launched in 1906 by the Electric Boat Company of New York and embodying the latest conceptions of this design of boat, the *Lake*, and a small model of the sub-surface type. The report submitted to the Navy Department shows the unanimous opinion of the board to have been in favor of the adoption of the *Octopus* type. The results of the tests as given in the report are summarized in an editorial review in a recent number of *Engineering*, which also contains some interesting details of the progress of the submarine boat in other navies.

"The *Octopus*, like the great majority of submarine craft, is driven on the surface by internal-combustion engines, and the consumption is such as to insure that, with a fuel storage supply of 4000 gallons, the radius of action will be 700 miles. Electric motors are used for propulsion when submerged. The surprisingly good speed of 10.03 knots was realized as a mean of three measured-mile runs with the conning-tower of the vessel 10 feet under the surface. This is a splendid performance. On the surface the maximum speed was 11.57 knots, and the mean 11.02 knots. As regards diving, the vessel went down at an angle of 8 degrees to a depth of 26 feet within 40 seconds; she immediately returned to the surface, remained there under observation for five seconds, and dived once more. The complete evolution was carried out in about a minute and a half. This facility of disappearance is of the greatest importance from the point of view of fighting efficiency, and the result is, therefore, most interesting. Again, the time taken to disconnect the gasoline engines and to couple the electric motors was only 12 seconds, five seconds for the former, and seven seconds for the latter operation. As to maneuvering, the vessel, when awash, made a complete circle in 3 minutes 40 seconds, the diameter of the circle being about 200 yards. Running on the surface, with only one screw, she made a half circle to starboard in 1 minute 35 seconds, and a half circle to port in 2 minutes 40 seconds; in the latter instance the screw propeller was working against the rudder. Going full speed ahead when awash, the vessel was able to reverse her direction of propulsion in 52 seconds. As to endurance, the boat was required to remain 24 hours submerged at a depth of 200 feet, and it was computed that only 1-45th of the total air supply was exhausted, which suggests a long radius of action under water.

"The *Lake* boat also did well in remaining under water for this lengthy period, but in the other tests the *Octopus* proved superior. The *Holland* boats are fitted with an automatic device for blowing out the tanks when submerged, in order that the vessel may rise to the surface from any predetermined depth, for which the apparatus is set to come into action. The mechanism was set to be effective at 40 feet, and when this depth was reached 30 tons of water were blown out of the ship in 18 seconds, the total time taken for the test, including the immersion of the boat, being 48 seconds. Another important trial was made in connection with submarine bell signals from the 'mother' ship, and by this means it was possible for the commander of the fleet to communicate to the various vessels when submerged. It was also found that wireless telegraphy could be used on the *Octopus* when on the surface and awash. The masts were 30 feet high, and the antennæ, 50 feet long, consisted of four strands of wire. Under these conditions it is anticipated that the range of communication will be 40 miles.

"These facts, which were evolved by the Government tests, again prove

the practicability of submarine navigation, which has frequently been demonstrated, although actual data have been withheld. The data further establish the efficiency of the *Holland* type of submarine boat, and 'that she is equal to the best boat now owned by the United States or under contract.' The results suggest that a larger boat than the vessel referred to, which is of 273 tons displacement, would be a superior weapon. As to the *Lake* type of boat, the Commission report:—'1. That the type of submarine boat as represented by the *Lake* is, in the opinion of the board, inferior to the type as represented by the *Octopus*. 2. The closed superstructure of the *Lake*, with the large flat deck which is fitted to carry water ballast, and to contain fuel tanks and air flasks, which is an essential feature of the *Lake* boat presented to us for trial, is inferior to the arrangement on board the *Octopus* for the same purposes, and also, in the opinion of the board, is detrimental to the proper control of the boat. 3. The hydroplanes, also an essential feature of the *Lake* boat presented to us for trial, were incapable of submerging the boat on an even keel. They are, therefore, regarded as an objectionable incumbrance.'

"As rgards the design known as the sub-surface type of boat, the Commission very properly reported that it could not be compared with submarine boats, being of an entirely different type. In this class of boat the machinery, magazines, and habitable quarters are enclosed in a submerged hull, from which there is communication to a surface hull through conning-towers or armored-tubes, the two hulls being joined, pretty much like the booms of a girder, by web plating or cellular structure. The surface hull is used only for the accommodation of the guns and the gear for controlling propulsion and navigation. In other words what would be considered the upper deck of an ordinary ship is separated from the substructure with the exception of tubes for communication, so that in action damage to the upper part would not affect or endanger the lower hull with the machinery and magazines. The system is ingenious, but is, as the Navy Board point out, analogous to the torpedo-boat or torpedo-boat destroyer. The sub-surface boat does not afford that advantage of invisibility which is the great desideratum met by submarine craft, and therefore its potentiality for damage is not so great. There was only submitted to the board a quarter-size model, and consequently it was impossible to make a satisfactory comparison, even with the performance of torpedo-boats and torpedo-boat destroyers. The Commission, however, point out that so far as their observation went there was no reason to doubt that the guarantee made as to speed, etc., would not be carried out. The sub-surface boat is less vulnerable than the torpedo-boat, requires fewer men, and has a larger steaming radius, but she has less speed and greater draft. The president of the commission, Captain Adolph Marix, took exception to the general pronouncement that the tests of the sub-surface model 'did not develop that boats of this type, built of a size suitable to render their qualities available, are equal to the best torpedo-boats now owned by the Government.' In the opinion of the captain, the smallest size of sub-surface boat fitted with a regular torpedo-tube, and built to give a speed of 15 knots, would be a weapon of great value, additional to any now owned by the Government, and that this value could be enhanced by the rapidity with which they could be constructed, and the ease with which they could be transported.

"The board were not called upon to pronounce as to the strategical or tactical advantages of the submarine boat. This was scarcely necessary in view of the general consensus of opinion in all Admiralties in favor of the type, and the large number now being built by the various Powers. In the recent Dilke return it was shown that there are already in existence 117 vessels of a submarine type, and that there are building 86; while the programmes of many Powers, in addition to the United States, anticipate very considerable additions. We, in Britain, have 37 completed and 11 on order, and the size has steadily advanced from 122 tons displacement to

400 tons, the power of the machinery having increased in the same period from 160 to 800 horsepower on the surface, while the power of electric motors for propulsion under the surface has increased from 70 brake horsepower to well over 200 brake horsepower. These vessels, as we have already indicated, have been evolved from the *Holland* type, and long experimental research has been carried out, with the result that no dubiety exists as to the efficiency of the type, while at the same time there is achieved that homogeneity which is so important in the training of the personnel to secure a sufficient supply of men during action, and to maintain the highest efficiency, which is dependent on thorough experience in these vessels more than in any other. France has 40 boats completed, and 59 are in course of construction. Here there is great diversity of opinion as to the best type of vessel, and the boats vary in size from 21 to 560 tons displacement. The tendency, however, is all in favor of vessels of large size, most of the boats under construction being of about 400 tons displacement. Russia has 20 vessels completed, and has on order 8. Germany has moved more slowly in this matter, but she has completed her first vessel and has two building; the estimates for the next three years provide about £350,000 for submarine construction. Italy has four vessels building, and two in course of construction. Japan has seven built, while the United States have in commission eight vessels, and four in course of completion, all of the *Holland* type." As noted above, seven additional boats of this type have been ordered for the United States Navy since this review of the trials was written.—*Engineering Magazine.*

ORDNANCE AND GUNNERY, TORPEDOES.

BRITISH GUNNERY ITEMS.—Modifications in the battle practice of the fleet have been approved to be carried out in the coming new year. The firing will, in future, be made from both sides of the vessel, half the authorized number of rounds being apportioned to each ship. A towing target is to be used if available, and a scheme of points will be arranged by which increasing values will be given to hits made by the more important guns. The order of merit of each ship will be determined by the ratio of the points obtained by her to the possible maximum of her armament.

The targets resembling torpedo-boat destroyers which are used by the *Revenge* for night firing, consist of obsolete torpedo-boats from which the engines and fittings have been removed, the interior being completely fitted up with cork so as to render the boats unsinkable. Canvas stretched on battens represents the funnels, masts, and superstructure, the whole being painted black. The targets are towed by destroyers at a speed of about 23 knots, and form good representations of torpedo craft.

"BACK-FLASH" FROM MODERN SMOKELESS POWDERS.—The recent terrible disaster on board of the Japanese battleship *Kashima*, in which over 40 officers and men were killed and injured owing to charges of modified cordite, while waiting to be loaded into a 10-inch gun, being ignited by the "back-flash" from the previous charge just fired, once more directs serious attention to an ever-present danger which threatens our own navy. Both nations use practically the same pattern of gun and absolutely identically the same "powder"—or, to be more precise, the same propellant—namely, modified cordite. The tale of these accidents is mounting up; the United States has to deplore the loss of many of her sailors from exactly the same cause, though the propellant used in the United States Navy is of a somewhat different type.

Briefly narrated, what happens is this: When a charge of modern smokeless propellant is fired, the shot issues from the muzzle, but inside the bore of the gun there is left a large quantity of various mixed gases at a high temperature. Owing to their nature, however, they themselves are not sufficiently rich in oxygen to cause a visible flame. When the

breech is opened there is an access of fresh oxygen from the atmosphere, and the hot gases then burst into flame.* If there is a draft down the bore of the gun from the muzzle to the breech, this flame is blown backwards a considerable distance to the rear of the gun, scorching and burning anything in its way. Should a charge of fresh propellant be ready behind the gun, waiting to be loaded after the shot is rammed home, it is not difficult to understand how there is certainty of terrible devastation, accentuated as it is by the small enclosed space in a turret, barbette, or casemate, and the further possible danger of the flame spreading to charges in the ammunition hoists and thence down to the magazines.

As the velocity of the projectile is increased in each succeeding type of gun, the charges of propellant rendered necessary are greater, and thus the danger from back-flash is intensified, owing to the larger quantity of residual gases being left in the bore.

It was appreciated some time ago in our navy that precautions must be taken to guard against such accidents as these, and the method since adopted is to expel the residual gases by an air-blast before the breech is opened; but this is at best a makeshift, and must unduly delay the service of the gun. Moreover, in the hurry of an action, sufficient time may not be given to the operation; nor if the ship is steaming to windward, or the guns pointing to windward, can it be safely depended upon to clear out all the gases.

The Germans seem to have solved the problem in a much more scientific and satisfactory manner by adopting for their navy in 1906 a propellant powder which gives no back-flash, even in their largest guns. This has replaced in their navy the modified cordite which is used at present in the British Navy. This final rejection, owing to the serious back-flash defect, in favor of the flameless powder, known by the designation C/06, is a consequence of searching trials, extending over four years since 1902, the "/06" denoting the year in which it was adopted.

The exact composition of this powder is kept secret, but it consists of a mixture of nitro-glycerine and nitro-cellulose and vaseline, in which, so far, it closely resembles the composition of our modified cordite; but there is, in addition, a small quantity of some chemical which has the effect of preventing back-flash at the breech, and in smaller ordnance no flame is apparent at the muzzle. This latter is a considerable advantage during night-firing, as the gun-layer of the quick-firing weapon is not blinded by the intense brilliancy of the flame usual with our cordite, whereby the speed of firing is reduced, and the accuracy of shooting impaired. It appears that the new German powder gives excellent shooting results.

So far as keeping qualities are concerned, the German powder is even better than our own cordite. This also is an important factor in view of the cordite explosions which have taken place from time to time in the magazines of British war vessels, fortunately, so far, without loss of life or of a ship; but similar good fortune may not continue. The report on these explosions has been kept extremely quiet, so that it is difficult to speak more fully of them; but on one occasion it was mere luck that a battleship was not sunk with all hands. Owing to this immunity from disaster, the public have not had their faith in the safety of ships in our fleet shaken in the same way as France quite lately was rudely awakened from her confidence in the excellence of the propellant powder used in her navy by the terrible disaster on the *Jena*. Apart, however, from the question of instability of a powder, which can be met to a large extent by the installation of refrigerating machinery for the magazines, there remains the equally important question of doing away with back-flash. So far no mechanical means have been devised to entirely obviate the danger therefrom, and recourse must therefore be had to the chemist's art.

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*It is thought that a spark of some sort is necessary to ignite the mixture. No part of the gun gets hot enough to do this.—P. R. A.

Germany has always been renowned for her progress in chemistry, and in no branch has she shown herself more progressive than in matters connected with explosives. There is no single authenticated case of which we know of where an explosion has occurred on a German vessel of war, and the reason for this seems to lie in an intelligent anticipation of possible sources of danger and in the steps taken to prevent them. For example, as soon as nitro-smokeless powders replaced the smoke powders it was at once realized that the dictum of former days "keep your powder dry" must be changed to "keep your powder cool." All ships in the German Navy were fitted with apparatus to keep the magazines cool, but our Admiralty only seem to have appreciated the importance of this during the past year, when the matter was forced on the attention of the Government by the accident which occurred on H. M. S. *Fox*, though several years previously a similar accident had occurred on H. M. S. *Revenge*. In both cases, by a simple chance, the loss of the ships and their crews, fortunately, did not occur.

Now, again, it would appear that we shall have to follow the lead given by Germany and adopt a powder which will obviate the danger of backflash in a proper and scientific manner.—*Engineering.*

EROSION OF GUNS.—With regard to the investigations of erosion of guns and mortars, an effort has been made to separate the effect of erosion of the bore due to the action of highly heated powder gases from the simple wear of the bore due to friction of the rotating band of the projectile and at the same time to arrive at some conclusion as to the grade of steel most suitable for the manufacture of gun tubes. The results of both the erosion and friction tests lead to the conclusion that the metal used at present in the manufacture of gun tubes is as satisfactory as any that can be obtained.

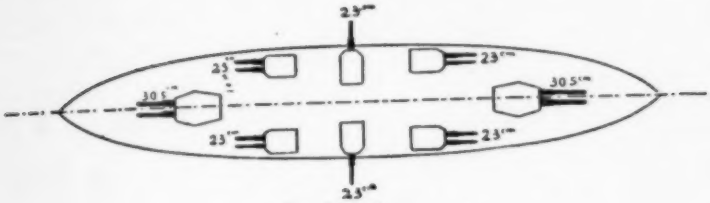
Causes of Erosion.—The most reasonable explanation advanced for the erosion of guns appears to be that the effects are due to the softening and washing away of a thin skin of metal at the surface, subjected to the highest temperature and pressure, at each round, by the extremely hot gases in contact with it. This explanation covers all the points which have been raised.—*Report of Chief of Ordnance, U. S. A.*

The report of the special committee appointed by the French Senate to enquire into the causes of the explosion which led to the destruction of the battleship *Jena* has been issued. It is in three parts, the first giving the views expressed by the committee, accompanied by plans of the vessel and the conclusions of the reporter, M. Monis. The reporter urges the necessity of more strict surveillance over the manufacture of the powders employed, in order to secure greater homogeneity and stability, both from the standpoint of safety and from that of their ballistic qualities. He proposes the use of freezing apparatus to keep the temperature of the powder magazines under 77 degrees Fahr. The reporter further dwells upon the necessity of greater precautions in the handling of the different powders, suggesting that the black powder should, if possible, be excluded from the ships. If that be found impracticable, then it should be kept isolated and removed from the B powders, which, according to the committee of the Senate, were the cause of the disaster.—*Army and Navy Gazette.*

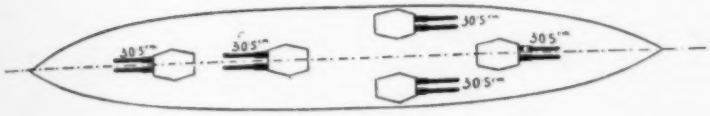
It has been decided to only repair the *Jéna* sufficiently to enable her to be used as a target for gunfire.—*Le Yacht.*

BATTERY PLANS OF RECENT SHIPS.—The following diagrams, from the *Mitteilungen aus dem Gebiete des Seewesens*, show the battery plans supposed to have been adopted in certain recent designs.

The *St. Vincent* class are said to differ from the preceding English ships

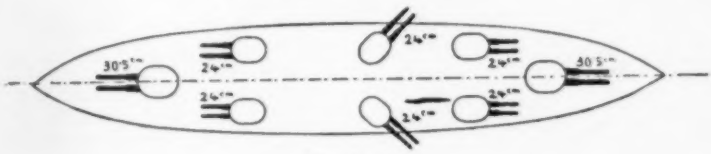


Lord Nelson.

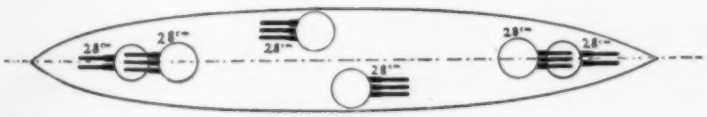


Dreadnought.

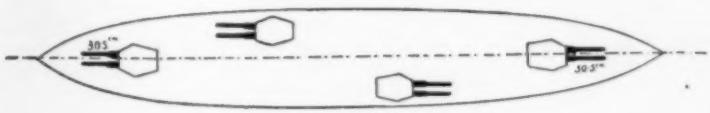
Michigan. South Carolina.



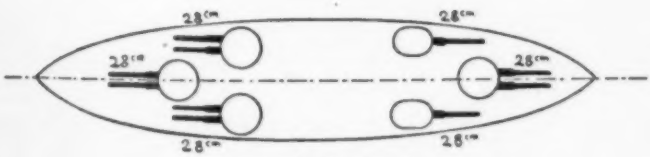
Danton.



Ersatz Sachsen.



Inflexible.



Armored Cruiser E.

by having all five of their 12-inch gun turrets on the middle line, as are those of the *Delaware* and *North Dakota*.

It is by no means certain that three-gun turrets will actually be installed on the *Ersatz Sachsen* class. The many inconveniences, difficulties, and disadvantages of this system are now apparently being recognized. The armored cruiser *F* is to differ from *E* merely by having twelve instead of ten 11-inch guns.

The French battleships which follow the *Danton* class are (as at present decided) to carry four 12-inch, twelve 9.44-inch, and eighteen 3.94-inch guns.

SAFETY LOADING ARRANGEMENTS FOR HEAVY GUNS.—The finding of the court which investigated the accident that occurred in the 8-inch turret of the *Georgia*, resulting in the death of 10 officers and sailors and the injury of others, appears to show that air-blast, as at present arranged in the U. S. Navy, for clearing the bore of the gun from after-gases, is not entirely satisfactory. Whatever else may be considered as uncertain, and the witnesses who could throw any real light on the cause of the accident were comparatively few, it appears to have been clearly established that what the Americans call "flare-back," but what is more commonly called "back-flame" in the British naval service, was the actual cause of the regrettable disaster.

There is, however, one question open to doubt apparently, and that is whether the air-blast was actually used at the gun at which the accident occurred before the charge which caused the explosion was ignited. On this point the court itself found that "All firing rules were observed and all safety precautions adopted, except it appears that after the firing of the right gun immediately preceding the accident, *the air-blast was shut off* (the italics are ours), and the ammunition car consequently brought above the turret floor before the bore was clear of the dangerous gases." Experts will best realize the importance of this pregnant sentence, for if this finding is in accord with the facts, the effectiveness of the air-blast in clearing the bore of dangerous gases after firing, is not impeached, as the blast had not apparently been used. It would simply have been an omission on the part of certain numbers at the gun, having taken risks, and suffered for them, in their keenness for rapidity of fire. Most of our recent gun accidents have occurred from similar causes, and in competitive firings the temptation to "scamp" is always present in a more or less degree, especially when the spirit of emulation is fully kindled and familiarity most readily breeds contempt.

Whether, however, this was the actual cause of the accident is left in doubt, as an expert examination of the evidence taken by the court, led the examiners to the conclusion that "After the accident the left gun was found loaded and the breech partially closed, the gun depressed about two or three degrees, and the ammunition car at the foot of the hoist on the buffers, with only the shell in, the powder having been removed when burning powder grains fell into the handing-room at the time of the accident. At the right gun (the weapon whose charge was actually ignited) the gun was found to be depressed two or three degrees, breech open, loading tray in the breech, *air-blast turned on, and blowing 112 pounds' pressure gauge in the turret*, the ammunition car at the top of the hoist with the controller off."

It will be seen by the italicised sentences above that the court and the experts who examined the evidence appear to have arrived at diametrically opposite opinions as to whether the air-blast was turned on or off. To gunnery men this will rob the report of much of its value, as the British service is adopting, after exhaustive experiments, the air-blast system of purging the bores of our large guns of "back-flame" after each round has been fired. At present a water-jet from a wash-out arrangement only is used in our own fleet. If the air-blast was used at the right gun in the *Georgia* turret, and a "flare-back" followed its withdrawal, strong enough

in force to rush out of the breech of the gun and envelop one of the gun-loaders and the charge he was handling, and to set fire to the material of which the cartridge bag was composed, then air-blast arrangements, as used in the *Georgia* on this particular occasion at least, were ineffective. If this had been proved to be the case, it would behoove our own authorities to see that a more effective plan is adopted for our own guns. Since the point is left in doubt, and our own experiments have been exhaustive and severe, we probably need have little doubt as to the safety of the system we are adopting in some of our latest warships.

A great deal depends on the force of the air-blast used, as to whether this method of driving dangerous gases out of the muzzle is, or is not, effective and safe. If the experts' opinion is correct that the "air blast was turned on and blowing 112 pounds' pressure gauge" after the accident, this, if used, should have been ample to have cleared the bore of gases, even against a strong wind blowing "down range," which is the most dangerous time, as then the draft from muzzle to breech is at its maximum.

There is another point of importance brought out in the report which goes to show that the Americans take hazards with their 8-inch guns which we are very careful to avoid with our own large turret guns. Mention is made in the evidence of the fact that one of the loading numbers stood with one of the charges in his hand when the bag containing the powder is believed to have been set on fire. With the 8-inch gun it is, of course, possible to "man-handle" the charges of the guns as our own 9.2-inch charges are handled; but with our larger turret guns the charges are kept covered in a metal cover until they are tumbled into a loading position in rear of the gun, and so are less exposed to what the Americans call "flare-back." This appears to be the safer plan, and should be possible of adoption, as their charges appear to have been served to the breech of the 8-inch gun of the *Georgia* in much the same fashion as our 12-inch charges are served in our oldest ships, viz., direct from the handing-room to the breech of the gun.

In our later ships a safeguard is introduced in the ammunition supply by a break in the service about half-way up from the magazines—in the case of the larger guns. This entirely removes all danger of burning grains falling from above to the waiting gun-charges below. Had it not been for the great presence of mind, the coolness and courage of some of the officers and men of the *Georgia* after the first explosion, there would doubtless have been a much worse accident, for the burning grains might have penetrated to the magazines through the handling-rooms below. This danger is, as pointed out above, averted in the later British warships by halving the service, and thus preventing direct communication between the breech of the gun and the magazines where their charges are stowed. This undoubtedly establishes a better arrangement, and since the service is so arranged that rapidity is not lost, the British method is undoubtedly superior, and affords the men and the ship more security should "back-flame" ever manage to light one of our large turret gun-charges.

The danger of this "flare-back" is, of course, peculiar to breech-loading guns, and although not responsible for so many accidents as the burning cartridge bag residue that smoldered in the old muzzle-loading guns, yet it has cost many lives since the introduction of B. L. guns, especially since slow-burning powders have been used, and our own navy has suffered with the rest of the fleets. Sponging with a saturated kind of mop-head was the method of removing the danger occasioned in the muzzle-loader by burning cartridge bag residue, and ejecting the flame from the bore by means of an air-blast at great pressure is the means of overcoming the "flare-back" of the modern breech-loading ordnance. Both of these agencies depend on careful manipulation by man for their effectiveness, and, unfortunately, man has ever erred since the fall, and when naval men

enter gunnery competition the statement that it is human to err is only too often realized, even when the death penalty is the sure and certain result.

The danger which besets our sailors from the cause to which the accident on the *Georgia* is clearly traceable, increases with every foot of the length of our guns, and we have advanced in this direction at a very lively pace during the last decade. Ten years ago a 40-caliber gun was considered a very long weapon; to-day our naval guns have leaped up to a length of 50 calibers, which in a 6-inch gun adds approximately five feet to its muzzle. To eject the flame, therefore, the air-blast will have to be increased with every caliber of length added to the gun if we are to keep the same margin of safety as exists to-day, after thoroughly exhaustive experiments. As, however, it is believed that the maximum of length has now been reached in guns built on our present models, extra air pressure may not be required to eject the "back-flame," which naturally takes longer to escape from a long gun than from a short one.

Taken as a whole, our safety arrangements in our loading and ammunition supply can be said to be in advance of other countries, and have more than once been admired by foreigners; while our cordite is proving to be more stable than most high explosives, even though it is sometimes necessary to promptly "jettison" an old "lot" that has been kept in a magazine close to the boilers in certain classes of our ships. Without being boastful, therefore, it is permissible to be grateful, and to acknowledge the great care that our Admiralty and constructors bestow upon the task of winning the confidence of naval men in their weapons and munitions, by introducing every possible safeguard into the designs of our men-of-war.—*United Service Gazette.*

EXPLOSIVES AND THEIR PROPERTIES.—As a result of the terrible explosion on board the French battleship *Jena*, there has since been a thorough overhauling of the explosives stored in the various arsenals and magazines in the United Kingdom, and large quantities of them have been condemned, a considerable amount being now in process of destruction in the neighborhood of Bull Point, Devonport. Similar measures were taken quite recently in India, as a result of a visit paid to that country by Lieutenant-Colonel Sir F. L. Nathan, superintendent of the Royal Gunpowder Factory, Waltham Abbey, but this visit had no connection with the *Jena* disaster, being prompted rather by the deterioration of much of the cordite and other explosives that had been stored in the Indian arsenals and ordnance stores, resulting in several serious explosions and outbreaks of fire.

The chemical reactions by which explosive substances are converted into gases vary very greatly in nature and rapidity, the latter fact determining the character of the explosive. Thus, when reaction through the mass of the explosive is slow, ordinary combustion is produced; when comparatively very rapid, the action is called "explosion"; and when practically instantaneous it is termed detonation. The pressure developed by an explosive in any given space depends upon the volume and temperature of the gases produced. The amount of work is proportional to the heat produced by the chemical actions involved in the decomposition of the substances. The force developed by a given explosive depends theoretically upon (1) its chemical structure and constitution, and the products of its decomposition; (2) the heat produced in the decomposition; (3) the nature and volume of the produced gases; and (4) the rapidity of the chemical action. Where combustion is complete it is possible to determine the products of decomposition and their amount with considerable accuracy, but when the explosive is not sufficiently rich in oxygen to ensure perfect combustion, these products will vary with the conditions of their production. The pressure of the resulting gases can be approximately measured by the ordinary laws connecting gaseous volumes and pressures, while the heat produced can be estimated from the chemical equations representing the various reactions involved.

Explosives may be divided into two divisions: (1) Those used to propel a projectile, and to open the shrapnel shell, and release the bullets; and (2) those used to explode common shell, generally styled "high explosives." Under the first heading we have gunpowder and cordite, while as "high explosives" are ranked lyddite, melenite, dualine, dynamite, Atlas powder, tonite, rackarock, rendrock, and giantpowder. Other explosives that are employed in the services for demolitions, and elsewhere for mining and similar purposes, are guncotton, cotton powder, blasting gelatine, and the Japanese shimose powder. Of all these, blasting gelatine contains the largest percentage of nitro-glycerine, viz.: 82 parts, with eight of guncotton; then dualine, 80 parts of nitro-glycerine and 20 of nitro-cellulose or guncotton; dynamite, 75 parts of nitro-glycerine and 25 of infusorial earth; Atlas powder, 75 parts of nitro-glycerine, 21 of wood-fiber, five of carbonate of magnesia, and two of nitrate of soda; tonite, 52½ parts of guncotton, 47½ of nitrate of baryta; rackarock, 77.7 parts of chlorate of potash and 22.3 of nitro-benzol; rendrock is a composition of 40 parts nitro-glycerine, 40 of nitrate of potash or soda, 13 of cellulose, and 7 of paraffin; and giantpowder, 36 parts nitro-glycerine, 49 nitrate of potash or soda, 8 of sulphur, and 8 of resin or charcoal.

Lyddite, freed from all technical description, is merely a form of picric acid brought into a dense condition by fusion. Picric acid is obtained by the action of nitric acid on phenol, or carbolic acid. Lyddite itself is a yellowish compound of the consistency of tallow. It is one of the most violent explosives known, and has the peculiar virtue of being totally unaffected by damp. It is somewhat difficult to detonate, and can be safely carried about in unfused shell. Its chief disadvantage is that special primers and fuses have to be employed with it in consequence of the difficulty of detonating it. There is rather a curious story attrached to its discovery, or rather rediscovery, for it was first discovered in 1771, and for a century and a quarter served a peaceful but very useful purpose as a dye for silk and woollen materials, without its explosive powers being dreamt of. Then, some years ago, a warehouse fire occurred in Manchester, and the flames spread to a shed in which picric acid was stored. There was a terrible explosion, and an investigation took place, with the result that lyddite was born. Melenite is employed by the French, and is very much akin to lyddite, but it is said to contain chlorate of potash, which, while making it easier to detonate, renders it highly dangerous to handle.

High explosives all require to be detonated, that is to say, they must simultaneously receive a shock and the application of flame to explode. This is generally applied by detonators of fulminate of mercury or chlorate of potash. When merely lit, they flame away in much the same manner as cordite.

The advantages obtained by the use of cordite are due almost wholly to the fact that the powder is practically completely converted into gas. The experiments of Noble and Abel show that the gases evolved by charcoal powders amount to only 43 per cent of the weight of the powder, and part of the energy of this quantity of gas is expended in expelling the residue from the bore. A smaller quantity of smokeless powder will therefore produce an equal weight of gas, and with smaller charges the projectile may be given equal or higher velocities. The smokelessness of the powder and the absence of fouling in the bore are also due to the complete conversion of the powder into gas. Cordite itself consists of 58 parts of nitro-glycerine, 37 of finely-divided guncotton, and five of mineral jelly. It is made in various sizes, and is broken up into very short lengths for use with revolvers. The ordinary sizes are designated by the size of the sticks in hundredths of an inch, and by their length. Thus size 50/16 signifies that each stick has a diameter of 50 hundredths of an inch, and a length of 16 inches. In addition to being smokeless and leaving little fouling in its use, it is unaffected by damp, and being a more powerful explosive than gunpowder, a smaller charge produces the same effect. It is, however, affected

by heat, which destroys it by melting out the nitro-glycerine of which it is composed. For this reason it is found necessary in tropical climates to store it in cool chambers, as is done in our battleships.—*United Service Gazette.*

PROTECTION AGAINST TORPEDOES.—The new French battleships of 18,000 tons will be provided, over almost their whole length, with an armored inner hull intended to safeguard them against torpedo explosion. This

Fig. 1

measure seems judicious, and the presence of this supplementary armor may result in reducing the importance of leaks caused by an under water explosion. But it is also possible that it may be of no use; certainly no one can affirm the efficacy of the system. Ever since the 1901 experiments against the *Henri IV* caisson, it has been well known that the special kind of protection aimed at in that vessel was illusory, and yet the method was nearly the same. As a matter of fact, we are too little informed as to the mode of propagation of the explosive effects to know how to arrest them; and it may well be that subdivision is the only effective means at our disposal whereby leakage can be localized and the ship's stability assured.

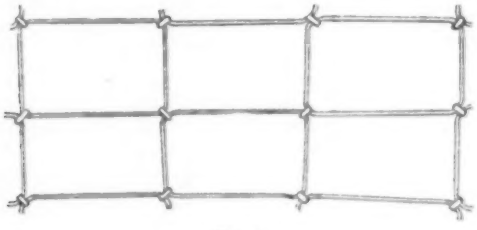


Fig. 2

But there is a surer way of arming oneself against torpedoes, at least in certain cases, and those, too, the most frequent ones; it consists in causing them to explode at a respectful distance from the ship by means of the metal nets invented by Bullivant. It is known that we used these nets for several years; then did away with them on account of their weight and the difficulty of handling them. At the time of their suppression, we were almost alone in having torpedo-boats, and submarines did not exist; we counted a great deal on our own torpedoes, but had nothing to fear from those of our adversaries. To-day, torpedo-boats and submarines

have been developed everywhere, if not as much as in France, at least to a considerable extent, and we must expect to be attacked by them. Consequently there is reason to consider which of us has been right, we who have given up, or other navies which have kept torpedo nets.

They have even perfected these nets, and England is at her third model in ten years. These changes have been necessitated by the invention of "net cutters," whose object is sufficiently explained by the name, and which are placed at the front of the torpedo to cut the links so as to make an opening in the net through which the torpedo can pass, and thus reach

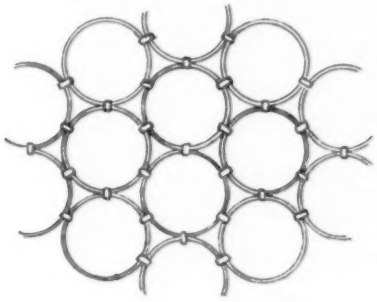


Fig. 3

the ship's hull. But for each kind of net, a different net cutter is needed, and, moreover, no one of these devices is absolutely sure to function. Besides, the net cutter retards the torpedo, may swerve it from its path, and, when the torpedo reaches its mark, causes it to explode further from the hull than it otherwise would, thus decreasing its explosive effect as well as reducing its chance of hitting.

The old French net (Fig. 1) was formed of round links of 15 cm. diameter, side by side, and tied together by iron rings. The links were made of iron wires twisted together.

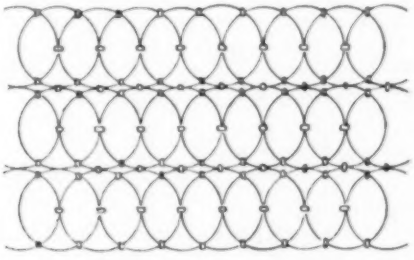


Fig. 4

The links of the German net (Fig. 2) are rectangular and of greater size, 20 cm. by 12 cm.

In the Russian net (Fig. 3) the links are round and arranged in diagonal lines; they are of 12 cm. diameter.

The English at first had a model like ours; in 1898 they replaced it by another much more complicated (Fig. 4) with 10 cm. links, evidently designed to meet the net cutters of that time; and quite recently they have adopted a new system (Fig. 5), quite different, which might better be called a casing than a net; it is made of flat steel rings, only 6 cm. in diam-

eter, one passing through another without any connecting rings. This veritable "coat of mail" serves as the outer covering of the new battleships of *Dreadnought* type. It seems, at first sight, particularly difficult to pierce.

The weight of these nets is naturally very different for the different models; it varies from 3 kilos per square meter for the German net, which is the lightest, to about 25 kilos per square meter for the latest English net. But the importance of the resulting extra weight on a battleship should not be exaggerated; if we suppose a net 6 meters high, completely surrounding a ship 180 meters long, and weighing 25 kilos per square meter, the total weight is 54 tons; that is very little, out of a displacement of 18,000 tons, even if 20 tons are added for the booms and the rigging. If this weight were taken out of the coal supply, it would reduce the radius of action at 20 knots from 1000 to 940 miles.

Admitting the principle of net protection, there is, however, no great object in economizing on the weight per square meter; if increasing it obliges us to also increase a little the power of the winches by which it is worked, on the other hand, the net will behave better when the ship is moving. Our old nets, which weighed only 5 kilos per square meter, lifted at 5 knots speed, and, dragging along the surface, no longer gave any protection. The last two English models, on the contrary, remain immersed and nearly up and down when the ship carrying them is moving at 10 knots speed. Under these conditions, nets permit a blockading force to approach nearer the shore and their rôle is no longer limited to protecting ships at anchor.

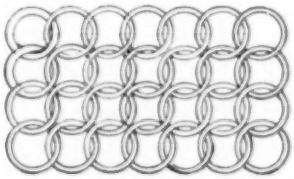


Fig. 5

As to the difficulties of maneuver, they are real—and that is the true reason of our giving up the use of nets; but they are not insurmountable. The English put out their nets of latest pattern, which are particularly flexible, in two or three minutes, and take them in, stowing them properly along the sides in the same time. What they have done, there is no apparent reason why we should not attain to doing.

The cost of a complete outfit for a large battleship is 100,000 francs (that is what the Admiralty pays to the Bullivant Company, which has kept the monopoly of the manufacture).

It seems to us that, if the necessity of supplying our new ships with this supplementary system of protection is not evident, it would be well at least to carefully consider the matter. The question could be submitted to the Counseil Supérieur de la Marine, for whose information there should be communicated an exact estimate of weight and cost as well as data concerning the performance of nets in the Russo-Japanese war; for both sides used nets, and it was due to them that the injuries caused by torpedoes were generally so slight. We should remember the numberless attacks of the Japanese torpedo-boats, from February to June, 1904, before Port Arthur, and still better the end of the *Sevastopol*, moored off the harbor, having disembarked her rapid fire guns for shore use, and having on board only a few men armed with rifles, and withstanding during five nights the furious assaults of the hostile torpedo-boats, her nets stopping nearly 100 torpedoes. A system of protection capable of such resistance is not to be despised, and its advantages are perhaps such as to outweigh its inconvenience.—Henry Bernay, in *Le Yacht*. (Translated by P. R. A.)

MARINE TURBINES AND GAS ENGINES.

The recent overhaul of the cruiser *Amethyst* has been extremely satisfactory as far as the turbines are concerned, the work involved being extremely small compared with that required by her sister ships fitted with piston engines.

POWER ESTIMATING FOR TURBINE STEAMERS.—There is one great feature about the adoption of marine turbines, which is that they have made naval architects and marine engineers think on new lines. Empirical methods of design, and a discreet copying of the last similar job, sufficed for the vast majority of work done for the mercantile marine when the comparatively slow running engine and propeller were adopted. In their case the margins were large in all directions; the propeller was—generally—nowhere near its breaking-down point, the link motion enabled a greater mean pressure to be used if the required power was more than the estimate, analyses of component losses were almost invariably ignored, and, with one or two exceptions, shipbuilders were content to trust the indicator, and base everything thereon. Consequently vital variables remained undisturbed for want of investigation that the turbine has since enforced, and lest anyone should be unduly assisted by the work of his predecessors, providence seems to have carefully arranged that this casual satisfaction with indicated horsepower and speed should also extend to the stokehold, and that the coal consumption should be measured while the water evaporated—and hence boiler efficiency as well—should be left undetermined. Consequently there arose a term—pounds of coal per indicated horsepower hour—that, while based on a good experience with innumerable vessels, was absolutely useless for scientific comparison of results. For the moment we are not so much concerned with the boiler end of estimating as with the term indicated horsepower. For up-to-date fast steamers it is as useless as nominal horsepower, as Kirk's analysis or Rankin's augmented surface method—excellent as they may have been in their day. Times change, and what we have to face now is the problem of foretelling the effective thrust needed to propel a hull of given dimensions at a given speed. The term that marine engineers will not only have to get into the way of using, but also of estimating, will be effective horsepower, and *not* indicated horsepower. Now, the horsepower actually required to propel a given hull has to overcome the (1) frictional resistance of the hull; (2) the wave making resistance; (3) the eddy resistance. The first of these can be calculated with considerable accuracy, though it is customary, by taking a higher value for the coefficient of friction than that originally found by Froude, to include eddy resistance with it, owing to the impossibility of separately determining the resistance due to this cause. Wave-making resistance is hard to determine without a tank, though some empirical coefficients do exist that give a close approximation for certain types of vessel, and careful analytical estimates from similar ships help us to determine the percentage of the total that it represents. In the case of tanks, when the resistance of the naked model has been determined, the effective horsepower is first calculated and the probable indicated horsepower arrived at by means of propulsive coefficients made up as follows: About 5 per cent is added to the E. H. P. of the naked hull for resistance due to appendages—rudder, bossing, shaft brackets, etc.—and the figure thus found is multiplied by about $\frac{1}{.85}$ for engine efficiency, and about $\frac{1}{.65}$ for propeller efficiency, and by a very small corrective for hull efficiency—that is, for the difference between wake gain and thrust augmentation due to the action of the screw. The net result is that the ratio of $\frac{E.H.P.}{I.H.P.}$ is about 50 per cent, but varies very considerably. For most vessels the value

is between 48 per cent and 56 per cent at full speed, but instances of greater and lesser values could easily be quoted. It is an interesting question as to how accurate tank horsepower is. Models of the same ship trid in different tanks give amazingly variable results, but with care and experience the resistance can be determined very closely.

Consider for the moment the analysis of power from the engine end. The indicated horsepower as given by the indicator is considerably in excess of that delivered to the propeller boss on account of friction in the moving parts. Until the genesis of the torsion-meter about four years ago it was very difficult to say what this loss was, as the testing of large marine engines against a brake was prohibitively costly. It was generally assumed—largely on the basis of trials of land engines against brakes or generators—to vary from 10 to 16 per cent, and it came as a considerable surprise to many when the Vulcan Company proved the mechanical efficiency of the main engines of the *Kaiser Wilhelm II* to be as high as 94 per cent in service. Even assuming the accuracy of tank trials, it was therefore impossible to determine propeller efficiency correctly owing to the uncertainty as to the power actually delivered to the screw. Now that this can be done with comparative accuracy, it is so far only attempted on turbine steamers, and we find ourselves in the position of gradually commencing to accumulate isolated facts on the subject, but without any means of comparing them with reciprocating practice, as torsion meters are very rarely applied to piston engines. When, therefore, it becomes necessary to estimate the power required for a turbine steamer, and consequently revolutions of shafts, weight of turbines, etc., there is no guide established yet by past practice enabling us to decide exactly what brake horsepower is required. If a tank is available, or rather if a store of tank data is at hand to estimate from, the matter is simplified at once. If not, the procedure is guesswork. An Admiralty coefficient for indicated horsepower is taken as if piston engines were to be used, and an equally approximate propulsive coefficient is assumed in order to arrive at the E.H.P. Consequently we find some cases of large margins, and others cut very fine indeed.

With the improvement in steamship performance the value of the coefficient should be rising in ships of all types; but as far as Channel steamers are concerned, there is now no indicated horsepower, and hence no trustworthy coefficient. The solution seems to be to substitute E.H.P. for I.H.P. wherever it can be done. It applies equally to both types of engine, and obviates the inclusion of undetermined losses in important estimates. The known propulsive efficiencies can be used, but the absolute values will change. Instead of taking, say, 240 as a suitable Channel steamer coefficient whose propulsive efficiency is known to be 54 per cent, our value in future will be 444. Unless some step like this is taken, and a new series of values compiled for a most useful formula, we are afraid that for all fast steamers its use and value for power estimating will rapidly wane. The same arguments apply equally well to proportions of boilers, to fuel consumption or relative weights; but at the present time we are in a transitory state on this question, and it is by no means easy to change over from the old-established symbols.—*Engineer.*

ELECTRIC MOTORS FOR SHIP PROPULSION.—Some time ago we described an interesting method of propelling ships, proposed by a Russian. Several vessels, constructed according to his ideas, were tried. The results of these tests have been reported rather briefly, but it may be said that they, at least, were promising. The idea of this system was to utilize the internal-combustion engine, with its high thermal efficiency. But to adopt this engine to propulsion, a transmission gear was necessary. That proposed was a generator coupled to the engine, thus supplying power to one or more motors driving an equal number of propellers. The electrical transmission gear was not only efficient, but made it possible for the engine

to run at its most efficient speed, while the speed of the propellers was that best suited to them. An incidental advantage of the system was the bringing of the control of the propelling motors directly under the hand of the pilot.

Now, a somewhat similar plan is suggested for steamships, by the *Engineering Times*, to overcome the difficulties which have been met in applying the steam turbine to this work. This prime mover is at its best at high speeds, while the propellers, for efficient working, should be driven at much lower speeds. Therefore, in order to drive directly, not only must the turbine itself be run at a speed lower than is best, and hence be large and expensive, but the propellers must also compromise and run at higher speeds than is desirable. These disadvantages are removed by interposing an electrical link. By using a high-speed turbine directly connected to a generator, the former may be designed for that speed which best suits it. Since there is no fixed relation between the speed of the generators and the speed of the motors, the latter may be built so as to suit the propellers. Hence, each mechanisms works at its most efficient speed. Moreover, the system not only gives the pilot complete control of his propelling machinery, so that he can regulate the speed at will, but it makes reversing possible. With the ordinary steam turbine equipment, a reversing turbine must be introduced. With the electric drive this turbine is eliminated. Further, on naval vessels, where most of the cruising is done at low speeds, but which must be capable of sustained high speeds when occasion demands, it has become customary to introduce a second set of turbines simply for cruising purposes. With the electrical system this unit is also eliminated. By these savings, and taking into consideration the smaller size of the high-speed turbine, as compared with the low-speed direct-current turbine, it is estimated that the introduction of the electrical link will not increase the weight of the equipment, nor its cost, and will, besides, give the advantages which have been enumerated.

At the present time we are not aware of any attempt to apply such a system to boat propulsion. A somewhat similar system has, however, been tried for self-propelling vehicles, although the prime mover in this case has generally been a gasoline engine. If, however, this arrangement proves satisfactory for railway purposes, there seems to be no reason why the electrical steamer should not also be successful.—*Electrical Review.*

THE INDICATED POWER AND MECHANICAL EFFICIENCY OF THE GAS ENGINE. (Abstract of a paper by Professor B. Hopkinson, read before the Institution of Mechanical Engineers.)—In the report of the Committee of the Institution of Civil Engineers on the Efficiency of Internal Combustion Engines, the following remark occurs:

"It would be desirable but for one circumstance to calculate the relative efficiency only from the indicator horsepower. But it appears in the case of gas engines, and especially gas engines governed by hit-or-miss governors, the indicator diagrams do not give as accurate results as is generally supposed. The diagrams vary much more than those of a steam engine with a steady load, and the mean indicator horsepower, from the diagrams taken in a trial, may, it appears, differ a good deal from the real mean power."

The opinion of the committee quoted above is obviously important, and may be expected to have a wide-spread effect in gas-engine testing. It throws doubt upon many of the efficiency tests of gas engines which have hitherto been made and published. Moreover, the method which the committee themselves adopted for getting the indicated power from the brake-power seems to require further investigation before it can be accepted as accurate. It may no doubt be assumed on the evidence of steam engine tests that under given conditions of lubrication the friction is practically independent of the pressure in the engine. But whereas in the steam engine the whole of the mechanical losses are to be ascribed to friction,

that is not the case in the gas engine, in which a considerable amount of power is wasted in pumping and is usually included in the mechanical losses. Moreover, with a given supply of oil, lubrication conditions in the steam-engine are practically constant, but in the gas engine that is by no means the case. Great changes can take place in the temperatures of the cylinder walls in a comparatively short time, and this will affect the viscocity of the oil and therefore the work spent in friction. The author therefore determined to undertake an investigation with the object of finding whether the indicator power of the gas engine does, in fact, vary so much and is so difficult of determination as the report of the committee referred to suggests. If it were found that the indicated power could be accurately determined directly, it was further desired to test, by direct comparison of brake and indicated power, the validity of the committee's method of getting the mechanical efficiency. Briefly, the conclusions reached are:

Conclusions of the Research.—(1) If precautions are taken to keep the pressure of the gas-supply constant, the diagrams given by the engine are remarkably regular, and whether the engine be missing ignitions or not, it is possible, by the use of a sufficiently accurate indicator, to obtain the indicated power from diagrams within 1 or 2 per cent. It seems probable that the difficulty experienced by the committee was due either to the essential defects, for this purpose, of the ordinary form of indicator, or to casual variations in the gas supply per suction due perhaps to variation in the gas pressure at the engine.

(2) The difference between I.H.P. and B.H.P. is rather less than the H.P. at no load under the same conditions of lubrication, mainly because of the difference in the power absorbed in pumping. In the particular engine tested by the author the error from this cause in obtaining the indicated power would amount to about 5 per cent. The friction is substantially constant from no load to full load, provided that the temperature of the cylinder walls is kept the same, but the influence of temperature is very great.

The engine used in the tests was intended to give a maximum output of 40 H.P. on the brake, and the following are the particulars of it: Cylinder, 11½ inches diameter by 21 inches stroke; speed, 180 revolutions per minute; compression space, 407 cubic inches; compression ratio, 6.37; compression pressure, 175 pounds per square inch absolute.

When exploding every time, the indicated horsepower at 180 revolutions per minute is 0.495 times the mean effective pressure.

The engine works the ordinary "Otto" cycle, governed by hit-and-miss. The ignition is by magneto. The engine was loaded by belting it to a dynamo, which also served to motor it round when required. The fuel used was Cambridge coal-gas. When an accurate measurement of brake-power was desired all-round rope-brakes were used, one on each flywheel, and as the measurements were such that the brake-tests only lasted a few minutes it was not necessary to use any water cooling. The engine was fitted with an exhaust gas calorimeter of the spray type.

For measuring the gas supply a standard holder by Messrs. Parkinson and Cowan, having a capacity of 10 cubic feet, was placed between the main gas supply and the engine, and as close as possible to the latter. In the ordinary running of the engine the holder stood at a constant level, the flow of gas into it just balancing the flow out, and under these conditions it served as a gas-bag, coming down by about 1-10th of a cubic foot at each suction of the engine. In a measurement of gas consumption the supply to the holder was cut off, so that the engine took gas only from the holder, and the quantity taken in a definite number of suctions (usually about 50) was noted. The indicator diagrams were photographed at the same time as this measurement was made. After the completion of the measurement the inlet pipe to the bolder was opened, and the counter-weights adjusted so that the holder slowly rose to nearly its highest posi-

tion, when the measurement could, if necessary, be repeated. It was possible in this way to read off the gas consumption correct to one part in 500, and, allowing for possible inaccuracies in the gas-holder divisions, small changes in temperature and pressure, etc., it may be taken as certain that the gas consumption given is within one-half per cent of the truth. This method of gas measurement is, of course, especially adapted for cases like the present, in which the actual gas used in a particular cycle or series of cycles is desired, but it may be noted that it is almost equally suitable for the measurement of gas consumption for a long period. It was found that it made no perceptible difference to the power given by the engine whether the inlet-pipe to the holder was open or closed, and it may be assumed therefore that the gas consumption remains the same under these two conditions. The rate of consumption determined by the holder may therefore be assumed to hold during the intervals when the holder is filling or is standing at a constant level. This method of measurement, which is much superior in accuracy to any meter, and is very convenient, might easily be applied to much larger engines, since all that is required is a holder of capacity sufficient to run the engine for about one minute.

The New Optical Indicator.—The first requirement for the investigation proposed was an accurate indicator. In order to get at all satisfactory results it was necessary to construct an instrument which could be relied upon absolutely to give the indicated power within 2 per cent. Further it was necessary that the instrument should be capable of working for long periods without breaking down, so that large numbers of diagrams could be taken under given conditions. The author's experience of indicating gas engines has convinced him that it is quite impossible to fulfil the first of these conditions, to say nothing of the second, with any form of pencil indicator. It is unnecessary to discuss here the various sources of error in the pencil indicator, but it may be noted that two of them, namely the inertia of the piston and looseness in the joints, are of especial importance in the gas engine.

The combined effect of this and of back lash is to increase the mean height of the diagram by an amount which, from the nature of the case, is quite uncertain, but which may easily reach 1-30th inch even with a new indicator in perfect adjustment. This error is in most instruments counterbalanced to some extent, and in many overbalanced, by that due to motion of the pencil at right angles to the piston bore.

To overcome both these defects of inertia and back lash it is necessary to reduce very much the motion of the moving parts of the indicator and to use optical means for mangnifying that motion. The diaphragm manograph first proposed by Perry and now in use to some extent as a commercial instrument in the form of the Hospitallier-Carpentier Manograph, is unsuited for accurate quantitative work for a number of reasons; the chief of which are that the displacement is not proportional to the pressure, so that the diagrams cannot be integrated by a planimeter, and that it is inconvenient to calibrate. The author therefore determined to get a new design of indicator of the piston and spring type with optical magnifying mechanism. In the form finally adopted, after a considerable amount of experimenting, the spring consists of a straight piece of steel strip held as an encastred beam in a steel frame. A piston slides in a bore communicating with the engine, the axis of this bore being at right angles to the spring and passing through its center. The pressure on the piston deflects the spring and so tilts a small mirror about an axis at right angles to the bore, the pivots of this mirror being carried on a steel frame. To give the other motion to the mirror, the whole apparatus (straight spring and mirror with its pivots) is positively connected to an eccentric on the crank axle by which it is rocked about the axis of the bore, thus giving the piston motion of the diagram without the possibility of any lost motion. This instrument is practically indestructible, and it has been left open to the engine for considerable periods

without giving it any attention. The vertical deflection is accurately proportional to the pressure, so that the diagrams can be integrated with a planimeter. Finally, the period of oscillation is only about 1-700th of a second with such strengths of spring as were used in the mechanical efficiency tests. The indicator is very easily calibrated by dead weights. The diagrams used in these measurements were photographed, but for many purposes it has been found sufficient to observe them direct by means of a telescopic arrangement by which they are projected as a bright light on to a transparent screen with vertical and horizontal scales. It is easy to plot the diagram on to a piece of squared paper, and its area can thus be obtained within 5 per cent without the trouble of photography.—*Page's Weekly.*

RADIO TELEGRAPHY.

TRANSATLANTIC WIRELESS TELEGRAPHY ESTABLISHED.—As had been promised by Mr. William Marconi, on Thursday, October 17, wireless service across the Atlantic was opened. This transmission takes place between Glace Bay, Nova Scotia, and Clifden, Ireland. During the first day, it is said, ten thousand words were transmitted altogether, in both directions. These included a number of enthusiastic congratulatory messages in recognition of the important event, and prophesying the benefits to humanity which must follow from the developing and putting into actual service of the new system of communication. Judging from the reported success of the first day's public trial, there is no reason to expect anything but continued good working, so that the date on which this service was inaugurated is an important epoch, not only in the history of wireless telegraphy alone, but in that of all systems of communication. It is true, of course, that for some time past Mr. Marconi and others have said that they had maintained excellent communication across the Atlantic, but when a system is put into service, as now has been done, it must be considered as having passed out of the experimental state and entered into one of actual use. Moreover, since the announced rates for transmission are very much lower than those of the cable companies, in spite of the fact that the latter system has been in service for about 40 years, the new system can certainly expect to secure as much business as it can handle. Just what proportion of the whole this will be remains to be seen. It must be remembered that at the present time at least, these two stations can send but a single message at a time, and the rate of transmission is not high.

No one can tell now what place the wireless, or rather the radio-telegraphic system will take. The expense of the apparatus is trifling compared with that of the cable, and it will not be subject to breakdowns, or failures, in parts a mile or more under water. On the other hand, the problem of preventing interference between stations has not yet been completely solved, so that the application of the system must yet remain somewhat limited. Nevertheless, the possibilities are very great. There seems to be no reason now why communication with the Antipodes may not be established, provided, of course, sufficient power can be radiated. But if everyone else must be silent while one of us is talking to Australia, the system is, in one sense, handicapped.

Whatever may be the outcome of this telegraphic development, certainly Mr. Marconi must be given all credit, not only for the truly wonderful work he has done, but also for his faith in the system and his persistency in carrying it from good to better. To-day he is applauded by all the world for his magnificent achievement, and his work is greeted by the wondering praise of people grown accustomed to modern wonders, but who, to-morrow, when "little men, of little souls, rise up to buy and sell again," will turn to some new feat, forgetting the real importance to civilization of the system which Marconi has put into service.—*Electrical Review.*

CULMINATION OF WIRELESS TELEGRAPH IMPULSES AT THE ANTIPODES OF THE SENDING STATION.—The letter from Mr. Ernest F. Smith in our correspondence columns this week on the subject of the intensity of wireless telegraph signals at great distances from the sending station affords an opportunity for interesting speculation. Mr. Smith points out, although the same suggestion has been published before, that a wave which spreads at uniform speed and with uniform attenuation in all directions from a sending station on a sphere, should continually weaken in local intensity until it reached the equator of the globe with respect to that station. Beyond that distance the wave front tends to shorten and not to lengthen, until at the antipodes of the ending station it should tend to collect into a point with a splash or culmination. This would depend, of course, upon whether the rate of absorptive attenuation fell below a certain critical value. If, for instance, the absorption were so great as to make the wave inappreciably faint at a distance of say 100 miles, then it is clear that there would be no use looking for an antipodal splash 12,000 miles away. On the other hand, if the wave could be safely detected up to the equator from the sending station, or up to the ring 6000 miles off, so as to start fairly on its narrowing career, it would be reasonable to hope for a distinct culmination at the antipodes. Thus far we believe that there is no authentic or reliable information as to the reception of signals over 6000 miles away from their base, though there have been certain newspaper reports. There is, of course, no reason why they should not be found at such distances, if they are sufficiently strong at the start. All wireless telegraphists scattered about the ocean world should be encouraged to keep watch for and record of, faint signals from afar, in order to transfer antipodal wireless telegraphy from the class of interesting speculation into the class of determined fact.—*Electrical World.*

RECENT CONTRIBUTIONS TO ELECTRIC WAVE TELEGRAPHY.—Professor J. A. Fleming, in a recent Friday evening lecture at the Royal Institution, took as his subject the recent advances in wireless telegraphy. In commencing his address, Professor Fleming said that, though hardly more than ten years old, the system of wireless telegraphy by electric waves had developed immensely in its practical applications.

Every important navy had adopted the system in some form or other. With respect to the British, he was informed that it had been decided to fit it to every vessel larger than a torpedo-boat. At the same time over a hundred commercial vessels had been fitted with the Marconi apparatus. Concurrently with this practical development of the method there had been a corresponding advance on the scientific side. As in other cases, a stage was reached in which exact measurement was necessary to indicate the lines along which further progress was possible. In the case of wireless telegraphy, the things to be measured would be best comprehended by considering the nature of the phenomena involved. At each electric wire station there was an antenna which, in the case of a small station, might be a simple vertical wire, whilst in the case of a large one it might consist of 20 to 30 miles of such wires upheld by lattice towers. At the sending station this antenna was the seat of electric oscillations which gave rise to waves in the surrounding space. These waves fell on the antenna at the receiving station, and reproduced in it electrical oscillations which could be detected by suitable means. The state of the antenna and the space around it, previous to the passage of a spark, could be represented diagrammatically as in Fig. 1, lines of electric strain extending from the wire to the ground. When the spark passed these lines of strain were released; but in virtue of inertia the released electrons rushed to and fro along the wire in a series of oscillations. In so doing they set up a magnetic field around the wire, the direction of which was reversed at each oscillation. The point of reversal of this field spread out through space with the speed of light, and was accompanied by loops of electric strain, having their feet

resting on the ground. The distance between the maximum values of successive loops was known as half a wave-length. The power which the waves possessed of passing round obstacles depended upon this wave length.

Electric wave telegraphy formed a portion of the great science of radiation, which included optics and spectrum analysis, the fundamental laws of which were the same as for wireless telegraphy. In all cases of wave motion the relation $V = n\lambda$ held, where V denoted the speed of propagation, n the frequency, and λ the wave-length. Hence, if the periodic time of the vibration could be determined, the wave-length was also known, as V was, in the case under consideration, the velocity of light. The plan followed was, therefore, to bring near the emitting circuit, which had both capacity and inductance, another circuit having a variable inductance and capacity. These were altered till the two circuits were in tune, and it then followed that the product of the inductance and capacity was the same for both circuits, in which case the periodic time was given by the relation

$$t = \frac{\sqrt{C.L}}{5{,}000{,}000}$$

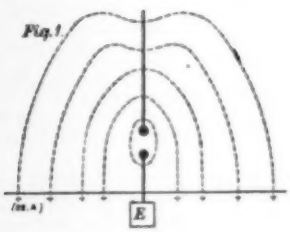
where C and L were respectively the known capacity and inductance of the secondary circuit. An instrument devised by him for the above purpose he had named a "cymometer." The inductance was provided by a long wire wound spirally, and the capacity by two tubes separated by ebonite, one of which could slide over the other. As a means of detecting when the two circuits were in tune, he used a vacuum tube filled with neon, which was connected to the terminals of the cymometer and glowed brightly when resonance was obtained between the two circuits, the indication being very sharp. These instruments were now made to measure wave-lengths ranging from 200 feet to 20,000 feet.

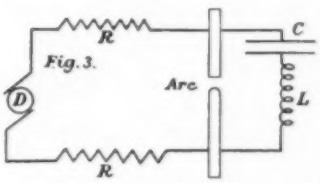
The cymometer might also be used to measure the decrement or damping of the waves. The waves emitted by an antenna fitted with a spark-gap died away gradually, each successive wave having less amplitude than its predecessor of the same group. The ratio of the amplitudes was the same for each successive pair of waves, and was called the "decrement." If this were known, the total effective duration of the group could be calculated; that was to say, the time in which the amplitude had diminished to 1 per cent of its initial value. Waves might die out rapidly or slowly, and it was also possible to produce undamped or persistent waves. In using the cymometer to determine the decrement, a very sensitive amperemeter, formed by a thermopile, was introduced into the cymometer circuit. This done, it was easy to plot out a curve, showing the relation between the natural frequency of the cymometer circuit, as its inductance was varied, and the strength of the current observed. After adding a small resistance to the circuit a second curve of the same kind could be determined, and from the two it was possible, as shown by Bjerknes and Drude, to determine the damping factor for the primary circuit. The amplitude could also be obtained, so that by means of the cymometer the wave-length, the number in the train, and the damping factor could be found.

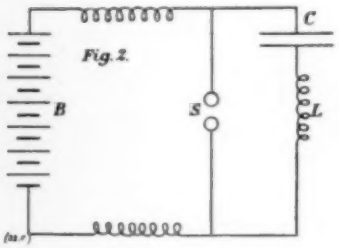
Various kinds of transmitting circuits had been used in wireless telegraphy. In general the aerial was charged by inductance, and then it might be either "closely" or "loosely" coupled with the primary, and, as a result, the oscillations emitted might be strongly or feebly damped. In the latter alternative each train consisted of many oscillations, and thus it was easier to get resonance in the case of the receiving circuit. Several methods had been proposed for getting an undamped train of waves. Thus a small alternator had been used by Mr. S. G. Brown. This ran at 6000 revolutions per minute, and gave waves with a frequency of 12,000 per second. The total power of the machine was, however, only 50 watts. It was, however, necessary in wireless telegraphy to have either a high frequency or a large power. With a frequency of 10,000 per second the waves

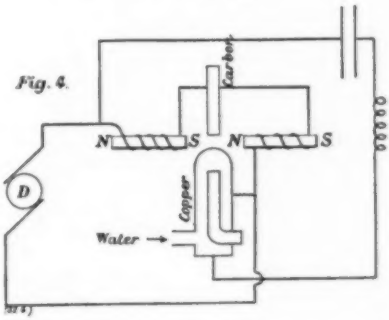
would be 100,000 feet in length, and very expensive antennæ, absorbing large power, would be required. Tesla, Elihu Thomson, Duddell, and Fessenden had all experimented along this line; but he believed that the highest frequency yet obtained from an alternator was 50,000 per second, and the power put into the circuit was small. The next method he would consider was the electric arc as a source of undamped waves. As in many other cases, this application had been foreshadowed by a sort of twilight before the dawn. Thus Elihu Thomson, in 1892, had, as represented in Fig. 2, shunted a spark-gap with a condenser, and observed that a high-frequency current was obtained in the condenser circuit.

In 1899 or 1900 Duddell had shown that if an arc lamp was shunted by a condenser and inductance, as in Fig. 3, a high-frequency current was again obtained round the condenser circuit. In 1903 Mr. Poulsen had made a further advance by making the arc between a carbon and a copper rod, the latter being cooled by water, and the whole arc surrounded by an atmosphere of hydrogen. At the same time a strong magnetic field was









established across the arc, as indicated in Fig. 4. In this way a much higher frequency was obtained. This method of producing undamped trains of waves was highly interesting and very important. It had been the subject of much investigation in the speaker's laboratory, where, at his (Dr. Fleming's) suggestion, Mr. Hudson, one of his research students, had determined the relation between current and potential for a carbon-metal arc. This had already been done for the carbon-carbon arc, and it was found that the potential fell as the current increased, a fact which was sometimes expressed by stating that the arc had a negative resistance; but he himself preferred to say that it had a falling characteristic curve. In the case of the metal-carbon arc this droop in the characteristic was much more marked, as would be seen on reference to Fig. 5.

He had a Poulsen arc on the table. The arc was enclosed in a brass box kept filled with coal-gas. The capacity in the circuit was small—merely 1/300 microfarad, or that of a large Leyden jar, whilst the inductance was large. As antenna he would use a long wire helix which had a natural periodic time equal to 1/200,000 second. The impulses from the arc must be supplied at exactly this rate, and when this was done, strong electric

brushes appeared at the terminals of the helix, whilst all around it was an intense alternating magnetic field. The waves emitted in this case were about a mile in length. With this apparatus Dr. Fleming showed many beautiful experiments. Every kind of vacuum tube glowed highly when brought near the helix, especially fine results being obtained with those containing neon, which gave quite a brilliant light. It was, however, an uneconomical method of lighting, as the apparatus took about 3 horse-power to work it. Tubes containing rarefied air also lit up, and soon became very hot, as the quantity of electricity oscillating to and fro in them was very considerable.

With the neon tube several important points could be established. In the first place, the great accuracy of tuning required; as a change of an inch or two in the position of the slider constituting the variable inductance in the primary circuit caused the glow to vanish, and a similar result followed when the lecturer brought his open hand near the helix, and thus slightly increased its capacity. By mounting a neon tube on a rotating axis he further demonstrated that the Poulsen vibrations were not quite continuous, as dark bands then became visible in the glowing mass formed by the rotating tube, showing that at certain points the light vanished. He had been trying to find a reason for this lack of continuity in the Poulsen oscillations, and it was, perhaps, partly due to a lack of uniformity in the speed with which the carbon member of the arc was rotated. This was done by an electromotor, and had to be effected with great smoothness. The brushes visible at the end of the helix he showed were actual flames capable of lighting a piece of paper.

The question might arise as to how the large currents in evidence were produced in the helix. This was effected in much the same way that a theater manager managed to represent on the stage a large army by marching to and fro a party of fifty supers. Similarly, the large currents in question arose from the passage to and fro of a small quantity of electricity. A 50-volt lamp connected to the terminals of the helix glowed brightly. Placing a coil of thirty turns of copper wire near the helix, Professor Fleming next showed that the currents induced in this could be transformed down. This was accomplished by bringing a coil consisting of a single turn of stout copper, short-circuited by a piece of fine iron wire, near this thirty-turn coil, when the iron first glowed red, and finally melted.

As to the theory of the musical arc, it had, he said, been likened to that of the organ pipe, in which the passage of air, through the opening, set up and maintained a set of stationary waves in the rest of the pipe. In the same way, when a condenser was put across an arc it first robbed the latter of current. This caused the potential difference across the arc to rise and more current to flow into the condenser. The latter next began to discharge back across the arc, and as the current increased across the latter the potential difference fell, causing a further flow from the condenser. When this was discharged the current fell off in the arc, and the cycle of operations was repeated. A carbon arc in air appeared to require a large capacity, and hence there was a limit to the frequency produced. With the carbon-copper arc in coal-gas, the characteristic, as shown in Fig. 5, was much steeper, and then much less capacity was needed. In the apparatus on the table the potential difference across the arc was 200 volts, but 1200 to 1500 volts were reached in the condenser, and some 60 to 70 per cent of the total energy involved was obtained in the form of the alternating current, which might have a frequency of one million per second.

As regarded the application of the system to wireless telegraphy, its announcement had been hailed as the death-knell of the spark-gap; but it was always a risky proceeding to issue an obituary notice of an invention prior to its actual decease. The Poulsen system was not free from drawbacks. It was much more complicated, and involved the use of coal-gas, means of keeping the carbon in rotation, and of preserving its exact distance from the copper electrode. Skilled attention was required, and it

was very difficult to maintain it in continuous work for more than a quarter of an hour. Further, it was difficult to work it with either a small or a large amount of power. An ordinary 10-inch coil, with which spark-telegraphy could be effected up to a distance of 100 miles, took but one-fifth of a horsepower, whilst the Poulsen arc could not be well worked with less than 1½ horsepower. Again, 100 horsepower could be applied to the working of spark-telegraphy, whilst this could only be done on the Poulsen system by arranging a number of arcs in series, which presented great difficulties. Mr. Marconi had, however, recently devised a purely mechanical method by which the energy from a continuous-current dynamo could be transformed into high-frequency alternations. Owing to pending foreign patents, he could not, he regretted to say, describe the system in detail that evening, but he hoped that Mr. Marconi would do so himself ere long.

Professor Fleming next proceeded to consider several types of detector for electric oscillations, taking first the electrolytic detector of Fessenden. This consisted, he stated, of a very fine platinum point dipping for about

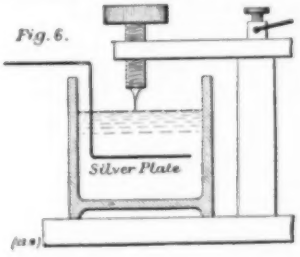


Fig. 6.

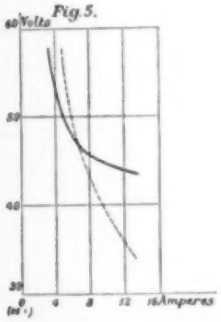


Fig. 5.

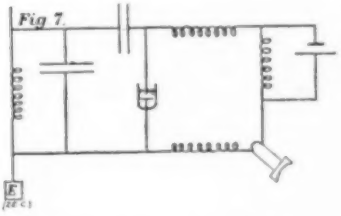


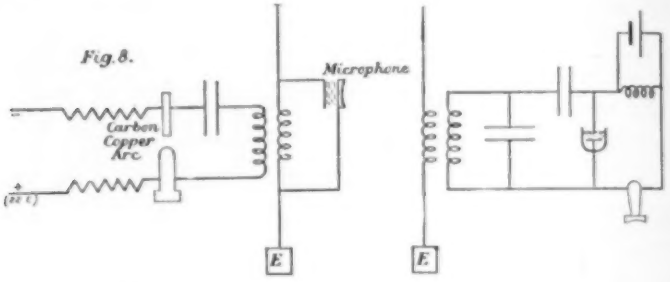
Fig. 7.

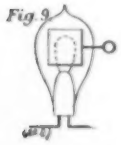
1 millimeter into an electrolyte of weak sulphuric acid, and acting as one electrode of an electrolytic cell. The other electrode was a plate of silver, see Fig. 6, and the apparatus when employed as a detector was arranged as indicated in Fig. 7. The platinum electrode became polarized by means of oxygen, but if an electric oscillation was induced in the circuit, this polarization was dispersed and the current through the cell momentarily increased, thus causing a sound in the telephone. The detector, it should be noted, acted not merely qualitatively, but quantitatively, and it had therefore been possible to apply it to wireless telephony. The apparatus for this was, he continued, represented in Fig. 8, and consisted of a Poulsen arc coupled up with an antenna, the transformer of which was short-circuited by a microphone, as indicated. The latter, when spoken into, varied the strength of the waves, but not their length, and hence a current of varying intensity was passed through the electrolytic detector, coupled to the receiving antenna. Speech had with the apparatus been maintained over a distance of 16 miles, and it would be quite possible to speak across the Channel.

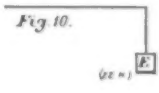
Another form of detector which also had the property of being a quantitative instrument had, Professor Fleming said, been introduced by himself

some years ago. It consisted, as indicated in Fig. 9, of a glow-lamp, the filament of which was surrounded by a cylinder of nickel. When the filament was hot, negative electricity could pass from the filament to the nickel cylinder, but not in the reverse direction, and the instrument therefore acted as an oscillation valve. When submitted to the action of electric waves the current between the filament and the cylinder was rectified; as all oscillations in one direction were filtered out, this unidirectional current would deflect a galvanometer. The sensitiveness of the device had nothing to do with the size of the filament, and he had himself used in some cases 12-volt lamps and in others 4-volt ones.

Hitherto the antennæ used had been upright wires, which corresponded to Hertzian oscillators half buried in the ground; but, as Fitzgerald had shown, a closed circuit, if the frequency were very high, also acted as an oscillator. This Professor Fleming demonstrated by using two square coils, in one of which a high-frequency current was set up, whilst the







other was connected to a galvanometer through one of the oscillation valves just described. The coils being in tune, this galvanometer showed a deflection which, it was stated, was not due to Faradaic induction, but to electric waves. Here, then, he continued, was a new system of wireless telegraphy based upon the Fitzgerald oscillator, as Marconi's was on that of Hertz; and this new system was, he thought, capable of considerable development. If the oscillation valve was not fitted, the galvanometer showed no deflection, since it was affected by continuous currents only. The efficiency of this oscillation valve depended much on the intensity of the incandescence of the filament.

The objection had been raised to wireless telegraphy, he said, that there was no privacy in the matter, as the waves spread out in all directions, affecting all instruments within range. A little progress had, however, been made lately in giving the waves a definite direction. About a year or so ago Mr. Marconi found that if the antenna was bent horizontally, as indicated in Fig. 10, the waves were more intense in the direction opposed to that of the horizontal limb, and that a receiver similarly bent was most sensitive to waves reaching it from the corresponding direction. Such an antenna radiated better on one side than the other, but there was still a considerable radiation in every direction. By bending down the antenna, as represented in Fig. 11, the proportion of radiation in the one direction could be increased; and by using three wires arranged so that the waves produced interfered with each other in certain directions, Professor Braun,

of Strassburg, had succeeded in keeping the radiation almost wholly on one side of the transmitter. Mr. Marconi had shown that these bent antennæ could be used for the purpose of locating a ship. A number of these were arranged round a receiver, and by coupling this to each in turn the direction of the ship would be given by the antennæ, which showed the strongest indications on the detector. By means of two such stations some miles apart the distance of the vessel could also be approximately determined.

In conclusion, Professor Fleming pointed out that, although much work had been done, large districts of research were still incompletely explored. The variable transparency of the atmosphere to these waves was, for instance, not yet fully explained. Very long transmissions were dependent, not only on special skill in devising the apparatus used, but also on the condition of the atmosphere. Sunlight, for instance, had been found prejudicial to the transmission of these waves. It was now known that there were numerous positive and negative ions in the atmosphere. These, when a wave passed, were moved by it, absorbing energy, so that an atmosphere charged with ions corresponded to a slightly turbid medium.

The lecture was illustrated by a large number of brilliant experiments. —*Engineering.*

WIRELESS TELEPHONY FOR THE U. S. NAVY.—Wireless telephony, as also wireless telegraphy, depends upon the production of electric waves that pass through the atmosphere, and also solid substances, with a velocity equaling that of light—186,000 miles per second.

In order to transmit either telegraphic signals or vibrations corresponding to those of the voice, it is necessary to interrupt or vary these waves at intervals depending on the signals or character of the sound. The production and transmission of the waves is essentially the same in wireless telephony as in wireless telegraphy, but their interruption is an entirely different matter. The vibrations corresponding to the human voice have an average rate of about 500 per second, for a man's voice, extending up to 20,000 per second for the overtones, while in wireless telegraphy, manually operated, it is possible to work at a rate of about five interruptions per second, the telegraph signals of course corresponding to the familiar Morse alphabet. In wireless telegraphy the receiving of the waves is accomplished by any one of a number of devices, such as the coherer, the magnetic detector, electrolytic responder, etc., but in wireless telephony there is need of a specially sensitive device, and this is realized in the Audion, which, devised by Dr. De Forest and adapted for both space telegraphy and telephony, has been found a specially valuable element in the latter. This instrument appears at first glance to be simply a small incandescent lamp, but there will be noticed a plate and a grid of platinum sealed into the bulb and connected with the exterior by platinum wires. The filament is of tantalum or other metal and is made to glow by a current from a small storage battery. At the transmitting instrument current is supplied at 220 volts from the ships lighting mains. This direct current flows through choke coils which prevent the high-frequency alternating current from passing, and then goes to the oscillator, which consists of an arc maintained in the flame of a small alcohol lamp. The production of high-frequency alternations from an arc was first discovered by Duddell in England and has been investigated by several physicists and experimenters, so that it was comparatively easy for Dr. De Forest to adapt the principle to his transmitting apparatus, although the actual application and the construction of a practical device required most elaborate and careful experiment. These currents with a frequency of about 40,000 per second pass through the primary of the transformer as indicated, a condenser being interposed in the circuit. The secondary of the transformer is connected with the antenna or aerial wire of the usual type used in wireless telegraphy, and to the ground through the microphone of an ordinary telephone transmitter. By adjusting properly the two circuits it is possible to pro-

duce in the ærial wire oscillations that will cause waves of the desired frequency to be sent out into the air. Now the vibrations of the voice acting on the microphone cause the resistance of the carbon granules to vary, consequently the resistance of the aerial wire circuit varies, and this correspondingly affects the amplitude or intensity of the waves emitted from the antenna, not cutting them off absolutely as in wireless telegraphy. Examining now the diagram for the receiving instrument, a similar aerial wire will be seen connected to the earth through one coil of a transformer,

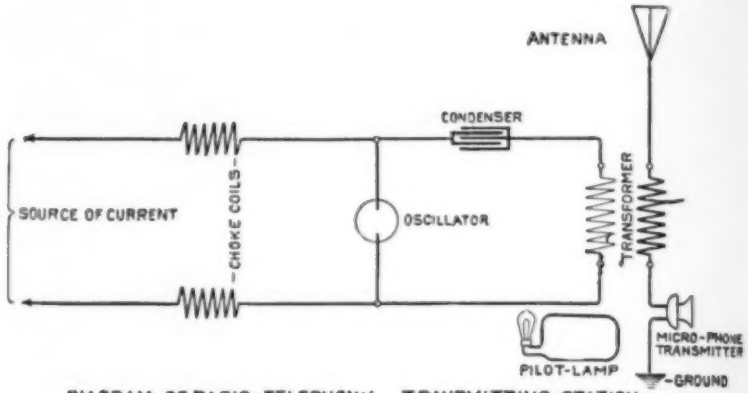


DIAGRAM OF RADIO-TELEPHONY TRANSMITTING STATION

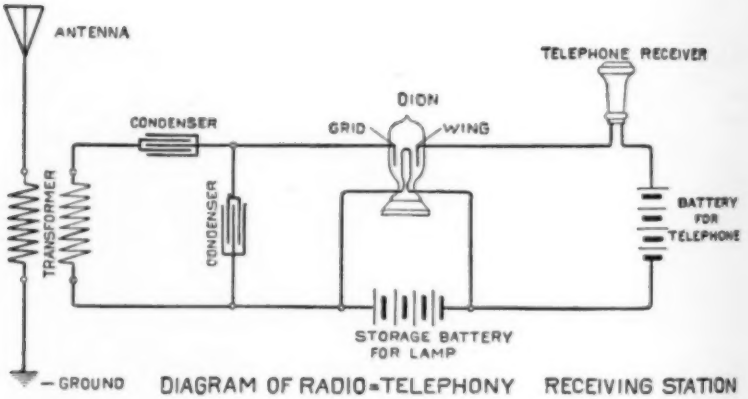


DIAGRAM OF RADIO-TELEPHONY RECEIVING STATION

while the circuit of the secondary includes two condensers, the audion with its storage battery, and the telephone with its cells. The electric waves impinging on the aerial wire set up a series of oscillations, which in turn are reproduced in the corresponding circuit of the transformer and affect the audion, causing the resistance of the gas ionized by the heat of the glowing filament to vary in proportion to the amplitude of the oscillations in the aerial wire, and the diaphragm of an ordinary telephone receiver is made to vibrate in the usual manner, reproducing the sound spoken into the transmitter.—*Scientific American.*

MISCELLANEOUS.

THE LUSITANIA.—The new Cunarders *Lusitania* and her sister-ship, the *Mauretania*, being intended to act as auxiliary cruisers in time of war, the following details taken from *The Times* may be of interest. The dimensions of the *Lusitania* are as follows:

Length over all	785 feet.
Length between perpendiculars	760 feet.
Beam, moulded	88 feet.
Depth, moulded	60 feet 4½ inches.
Gross tonnage	32,500 tons.
Draft	33 feet 6 inches.
Displacement	38,000 tons.
Type of engine	Parsons turbine.
Number and type of boilers	Twenty-five cylindrical.
Number of furnaces	192
Steam pressure	195 lbs.
Total heating surface	158,350 square feet.
Total grate area	4,048 square feet.
Draft	Howden's.
Total I.H.P. (designed)	68,000
Speed (designed)	25 knots.

One important feature dealt with in fixing the designs had reference to the use of the ships as cruisers or scouts in time of war, and the machinery—which is almost entirely under the water-line—has been so disposed in separate compartments, and with coal protection along each side, as to counteract, as far as possible, the effect of the enemy's fire at the water-line. For purposes of attack, the *Lusitania* will be provided with an armament as satisfactory as the armored cruisers of the *County* class, because on one of the topmost decks there will be carried, within the shelter of the heavy shell-plating, four 6-inch quick-firing guns, while on the promenade deck on each side there will be four more guns on central pivot mountings, also able to penetrate 4¾-inch armor at 5000 yards range, and 6-inch armor at 3000 yards range. With the great speed, which can be maintained for three or four times the period that any modern cruiser can steam even at only 21 knots, and with the careful sub-division for protection and their satisfactory offensive power, the *Lusitania* and her consort may be regarded as most effective additions to any fighting squadron. Their advent is, therefore, a great advantage from the point of view of British sea-power.

The rudder and steering gear are all placed well below the water-line. This is a most important point in respect of protection, should these vessels be ever impressed into the national service. The stern has been suitably shaped in the *Lusitania* to enable this object to be accomplished satisfactorily.—*Royal United Service Institution.*

THE HAGUE CONFERENCE.—Among the new rules of war adopted at the final sitting of the Peace Conference recently are three affecting the navies of the world, to which the various Powers concerned will be required to signify their adherence or otherwise before June 30, 1908. The first enacts that military hospital ships and hospital ships privately equipped, the names of which shall have been communicated at the opening or in the course of hostilites before being employed, cannot be captured during hostilities. Military hospital ships will be painted white, with a horizontal green band of about a yard and a half in width, while private hospital ships are to be painted white, with a horizontal red band of the like width.

The second new rule was obviously suggested by the progress that has lately taken place in the evolution of dirigible airships. It provides that the contracting Powers shall agree, for a period extending to the end of the third Peace Conference, to the prohibition to hurl projectiles and explosives by dropping them from balloons or by new methods of a similar

character. The declaration will cease to be binding when, in a war between contracting Powers, a non-contracting Power should join one of the belligerents. Should one of the contracting Powers denounce this declaration, the denunciation shall only come into force one year after written notification to that effect has been made by the denouncing Power to the government of the Netherlands, which will immediately communicate the denunciation to all the other contracting Powers.

The third rule, bearing on naval affairs, deals with the opening of hostilities, and enjoins that the contracting Powers recognize that hostilities between them shall not begin without previous unequivocal warning, which shall take the form either of a declaration of war with reasons assigned, or of an ultimatum accompanied by a conditional declaration of war. It is significant of Germany's attitude towards this last measure that Baron Marschall declared at the Conference in substance what amounted to a notification that Germany will be no party to any international compact that would limit, in the faintest degree, her freedom to make a sudden attack upon any nation with which she may have a difference of opinion. —*United Service Gazette.*

BATTLESHIP STRENGTH AND RELATIVE VALUE.—With October comes the intersessional political oratory, and this year we are promised a more than usually vigorous campaign. Two questions of interest to all connected with industry will be brought to the front: the one connected with trades-union organization and legislation, the other associated with naval strength and Admiralty administration. The former topic can only be considered when the demands of the labor socialist have been formulated. As regards the latter subject, the facts are indisputably in favor of the Admiralty policy during the past three years or so. We shall, as ever, be confronted with lists which state that Great Britain possesses so many battleships, that France, Germany, the United States of America, etc., possess so many; and starting from this hypothesis, articles will be written to prove that either now, or at some date in the comparatively near future, the first-named Power will be overtaken and passed, and that the sea supremacy, which none deny to her in the present, will then be dangerously jeopardized. But the writers and speakers who merely count units—units which are described as battleships—do not always analyze, and lay before the public which they address, the data concerning the vessels mentioned in these lists.

If a comparison is to be of any value, it must take into account not only the number of ships, but also their fighting capacity. As an example let us see in what way the Channel fleet, under the command of Lord Charles Beresford, will be constituted in the immediate future. It will consist of eight ships of the *King Edward VII* type, and six of the *Formidable* type, fourteen battleships, forming the most powerful and also the most homogeneous force, which is an all-important matter, in the whole world. Of the first type mentioned, the oldest was launched in 1903, the youngest—the *Hibernia*—in 1905. These eight ships each carry four 12-inch, four 9.2-inch, and ten 6-inch guns, as well as small guns and five submerged torpedo tubes; their armor is 9-inch Krupp amidships, tapering to 6-inch and 2-inch; their horsepower is 18,000, and their speed nearly 19 knots, their tonnage being 16,350 tons. The *Formidables* are older, November, 1898, being the date of the oldest of the class, and their size is smaller, being 15,000 tons, carrying four 12-inch, twelve 6-inch, besides small guns and four submerged tubes; the horsepower is 15,000, and speed 18 knots. These details are given in order that comparisons may be instituted between this, the principal British fleet, and the ships of foreign Powers; showing the relative strength of the units which go to make up their fleets, as well as our own. The home fleet, which contains the *Dreadnought*, and the Atlantic fleet are purposely left on one side in order to avoid confusion.

The Navy of the United States of America has, of late years, outstripped

that of France and taken second place, next to our own. Undoubtedly, however, the *Dreadnought* took the Americans by surprise, and since her trials and the demonstration that this new departure was a success, they have been attempting to make up their leeway. If we go back to 1898, the date of the oldest of the *Formidables*, we shall find that the United States built in that year the *Kearsarge* and *Kentucky*, of 11,500 tons, carrying four 13-inch, four 8-inch, and fourteen 6-inch guns, with a 16½-inch Harvey-nickel armor belt amidships; the horsepower is 10,500, and speed 16 knots. In the same year were built the practically identical ships *Alabama*, *Illinois*, and *Wisconsin*—as far as tonnage was concerned—but the armament of which differs considerably from that of the *Kearsarge* and *Kentucky*, as, instead of four 8-inch, they carry fourteen 6-inch guns. It will be observed that the *Formidables* are superior in nearly every respect, and have the enormous advantage of homogeneity. In 1901 the United States built the *Maine* class of three ships, of a tonnage of 12,500, carrying as their main armament four 12-inch and sixteen 6-inch guns; horsepower, 16,000, and speed, 18 knots. In 1904 came the *New Jersey* class of five ships, of 14,948 tons, with four 12-inch, eight 8-inch, and twelve 6-inch guns; horsepower, 19,000, and speed, 19 knots. In the same year came the *Louisiana* and *Connecticut*, of 16,000 tons, with practically the same armament; and in 1905 came a reversion to a smaller type—the *Idaho* and *Mississippi*, of 13,000 tons, with eight 7-inch guns, instead of twelve 6-inch. The *Kansas* class, of 16,000 tons, also date from 1905, and carry the same guns, except that they have twelve instead of eight 7-inch guns, and that with a horsepower of 16,500 their speed is 18 knots. In 1906 the first of the *South Carolina* class was laid down; and in this ship, and her sister, the *Michigan*, comes a foreshadowing of the future, as with a displacement of 16,000 tons their armament is eight 12-inch guns, the speed and horsepower remaining the same as in the case of the *Kansas* class. But the *Dreadnought* had seized upon the American imagination, ever prone to indulge itself, both by sea and land, with the biggest thing going, and two ships, forming the *Delaware* class, are to be laid down during the present year; their displacement is reckoned at 20,000 tons, and their armament will be ten 12-inch guns. In considering the available battleships of the United States, we shall see that, supposing them all to be in commission and ready for sea—which they are not—they could oppose 21 to the 14 of our Channel fleet (which are ready and in commission), that five of these are vessels of 11,500 tons, and that homogeneity would be far to seek. Of *personnel* it may be stated in passing that the United States Navy is short some thousands of men; and although the officers responsible say that this deficit could easily be filled, it cannot be considered that the navy is an efficient service until this is done; and, in spite of official optimism, the supply of free-born white Americans who seek to gain a living on the sea is by no means on the increase.

The importance of the French Navy has been always reckoned as one of the most potent factors in keeping the balance of European armaments; but it cannot be said that of late years the great Republic has kept up her ancient fame in this respect. This is no place to deal with the political aspect of affairs, but the man who has followed with intelligent interest the doings in the French Navy, and the French arsenals, for the last five or six years, would be blind and deaf to patent facts did he not recognize the enormous mischief wrought, both in the disciplined service and in the great industrial undertakings with which its upkeep is maintained, at the hands of a socialistic Minister of Marine. Dearly is M. Gaston Thomson paying for the policy of his predecessor, M. Camille Pelletan, the Socialist, and dearly are the country and the government paying in bad discipline and slackness among its employes, as well as in the more vulgar and tangible asset of hard cash. Thus it is that in relation to the French fleet of the present day one finds some difficulty when it comes to comparison of battleship strength, as no battleships were laid down for more than three

years, and the last of the 1900 programme has only just left Saint-Nazaire for Brest, to begin her trials. Not only was incalculable mischief done to discipline and the morale of the fleet and dockyards—witness the strike of the Inscrits Maritimes at Toulon three summers ago, and the antics of that most militant union, the "Syndicat Rouge," in the dockyards; but also the Minister considered that, in addition to anything else, it behoved him personally to advise as to the class of vessel upon which the naval credits voted were to be spent. M. Pelletan decided against battleships, and perpetuated the error of Gabriel Charmes and the "jeune marine" of the early eighties, who declared that the day of the "capital ship" had come to an end as soon as the automobile torpedo became a practical and accomplished fact. Gabriel Charmes and his school pinned their faith upon torpedo-boats of great speed, but the sea soon demonstrated that such craft were of small value in heavy weather. The submarine, in like manner, became the obsession of M. Pelletan, and on the submarine and the "petite marine," or small craft, has all the money been spent of late years. At last, however, saner counsels have prevailed, and France has started to make up all the leeway that she has lost.

It is impossible in the present day to consider that the *Charlemagne* class, of three ships which date from 1895, are of very much fighting value. They are, however, still on the active strength of the navy; they are 11,200 tons, and carry four 12-inch and ten 5.5-inch guns. The *Iéna*, dating 1898, was, as all the world knows, blown up at Toulon in March of the present year. The *Suffren*, 1899, is 12,750 tons, and carries four 12-inch and ten 6.4-inch guns; horsepower, 16,200; speed, 18 knots. The list closes with the *République* (1902) and *Patrie* (1903), of 14,865 tons, carrying four 12-inch and eighteen 6.4-inch guns; and the *Liberté* class, of four ships, of 14,900 tons, with four 12-inch and ten 7.6-inch guns; horsepower, 18,000; speed, 18 knots. But "mastodonte," as the French aptly call the craze for big ships, has seized also upon the Republic. At last common sense has regained her sway, and with it recognition of the fact that to be strong on the sea you must possess ships capable of lying in the line-of-battle. Therefore there have been laid down six ships—the *Danton* class, of 18,400 tons, to carry four 12-inch and twelve 9.4-inch guns. Further than this, it has been recognized that the worst of all economies is to keep ships too long upon the stocks, and in consequence, instead of seven years, it is designed that the *Danton* and her five sister ships shall pass into the active service four years from the date upon which their keel-plates were laid.

Their fleet, both war and mercantile, is among those things of which the Germans are the most proud—and with reason. The Kaiser on a memorable occasion declared that "the future of Germany is on the sea," and to do him justice, he has never ceased, in season and out of season, to do his best to ensure that that future shall be prosperous. Germany, like every other nation, piles ship upon ship and gun upon gun, protesting loudly all the while that nothing is further from her thoughts than war; this, of course, is all part of the game, and nobody minds, because we all do and say the same thing. But it may be permissible to doubt whether Germany does not view the development of "mastodonte" in warships with greater dismay than any other nation. The Fatherland was really getting along very nicely in the naval way until the arrival of the *Dreadnought* put all her plans astray. There is one thing that neither King, Kaiser, nor Republican President can alter, and that is the physical configuration of the land in which they dwell, and Nature has ensconced Germany behind one of the most intricate and tortuous labyrinths of sandbanks which exist in the world. Very useful are such natural defences against a potential maritime enemy, but when a nation wishes to develop into a great maritime Power, they embarrass it almost as much as they would do its foe. As at present constituted, the German Navy possesses no battleship of over 13,200 tons, and has afloat no gun of a greater caliber than 11 inches. There are five of the *Braunschweig* class, dating 1902-3, and five of the *Deutschland* class,

dating 1904-6, of this tonnage, carrying four 11-inch and fourteen 6.7-inch guns; horsepower, 16,000; speed, 18 knots. There are also five *Wittelsbachs*, of 11,830 tons, and five of the *Kaiser* class, of 11,150 tons, carrying four 9.4-inch and eighteen 6-inch guns, 15,000 and 14,000 horsepower and speed 18 knots. The *Brandenberg* class, of four ships, date from 1891, and are of 10,060 tons.

If we compare these ships, of which the German high sea fleet is composed, with the Channel fleet alone, we need not, at all events, fear the comparison. But Germany has further ambitions and the "mastodons" which she has projected are the *Sachsen*, *Baiern*, *Baden*, and *Würtemberg*. They are to have a tonnage, it is reported, of 17,710 tons, possibly 19,000 tons—but apparently nothing definite has been settled—and are to carry sixteen 11-inch guns.

The most modern battleships possessed by Japan are the *Kashima* and *Katori*, dating 1905; they are 16,400 tons, carry four 12-inch, four 10-inch, and twelve 6-inch guns, have a 9-inch Krupp belt amidships, horsepower 17,000, and speed 18.5 knots. Our allies, however, are, perhaps, further advanced than any other nation except ourselves along the road of big-ship building, as the *Satsuma*, of 18,800 tons, is already in the water, and her sister ship is advancing towards completion. There are also one ship, as yet un-named, building, and one projected of 20,750 tons.

Of Russia there is but small need to speak at present, as her navy is in an embryonic stage. Even when it is completed, it will not rank very high in the estimation of the world unless its methods of training are vastly different from those which obtained before the Russo-Japanese war.

Italy projects to lay down three or four ships of 16,000 tons; but those remarkably able men, the Italian constructors, have always held that for their country moderate tonnage would suffice, and to-day 16,000 tons represent moderation.

Austria is more modest still, as 14,500 tons is the limit, as far as is known, to which she will go at present in big-ship construction. There are other countries also which possess warships; but, as far as battleships are concerned, they may at present be left on one side.

The conclusion of the whole matter would appear to be that, for the present, England is in a satisfactory position. But the pace is being forced all along the line, and our rivals are striving to overtake and to surpass us. If this fact is kept in mind by our politicians, we need not fear for our supremacy, for we can build faster than any other nation, and certainly quite as well. The danger is that we may presume on our abilities, and defer our preparations too long. Fortunately, all parties are agreed that the British Navy must always remain supreme on the seas.—*Engineering*.

THE DEVELOPMENT OF THE MOTOR BOAT.—The rapid development of the motor boat during the past few years has been one of the direct results of the enormous growth of the automobile industry. Motor-boat building can as yet scarcely be called a separate industry, but that it is rapidly attaining that position is evidenced by the large number of firms who are interesting themselves in its development and by the attention which is being paid by engineers to the problems connected with the application of the internal-combustion engine to marine propulsion. An interesting sketch of the development and present status of the motor boat was recently given by W. Kaemmerer before the *Verein Deutscher Ingenieure*, of which the following is an abstract.

When one considers the share of the various countries in the development of the motor boat, the industry is seen to be a direct result of the development of the automobile, for France has taken first place in motor-boat building also. This applies, of course, less to boats for commercial and general use than to racing craft, in which department French builders have been unusually successful. That racing trials, for which such boats were primarily built, have an important technical value aside from their

sporting interest is easily seen from the progress of French motor-boat building, which certainly would not have attained its present status if the stimulus of the racing fever had been lacking. One of the most important results which must be attributed directly to the prevalence of the sport in France was the gradual lessening of the weight of the motor. Some of the results obtained in this direction were quite wonderful, the Société Antoinette, for instance, producing a motor which had the almost incredibly small weight of 1 to 1.5 kilograms per horsepower and was, at the same time, an efficient and safe machine. To the influence of racing must also be attributed a great deal of the development of the motor boat in Italy, where it has attained a high degree of perfection. All the principal firms connected with the industry produce the boat complete and on that account have attained excellent construction. In England, Germany and the United States motor-boat building seems to have been taken up more on the practical and commercial side, and, although some firms in each country make a specialty of racing craft, by far the larger number of boats built are designed for commercial and general service. The United States leads in the number of firms which produce motor boats as a part of their regular output and many of them are attempting to build up a large export trade by the establishment of branch houses in Europe.

The applications which may be made of the motor boat are very numerous, but, aside from pleasure craft, the greatest interest has been paid to its applications in the navy and its associated interests. The Italian Navy has been especially active in this regard. That the motor boat has not had a more rapid and general development is due to the peculiarities of the internal-combustion engine in its present condition. Of these, high speed and low efficiency of screws and the difficulties of reversing and speed regulation have been the most important factors in retarding development. The difficulty of speed regulation is a great drawback in heavy weather: to maintain a high speed in a small boat on a heavy sea results in filling the boat so full of water that it must either capsize or sink. The question of fuel is still unsettled. The use of benzine is attended with great risk of fire unless great caution is used. Recently the effort has been made to substitute petroleum or other heavy oils for the commonly used benzine. The general introduction of these oils would greatly reduce the risk of explosions and also operating costs, but would necessitate alterations in the design of motors.

The British Navy seems to have in view the application of internal-combustion motors to larger vessels, which, unlike the auxiliary boats of the larger ships of the squadrons, are designed to constitute a distinct fighting unit. These are what are known as motor torpedo boats. The first representative of this class was brought out by Yarrow & Co. in 1906. The vessel is 18.28 meters long and 2.74 meters beam and the draft is from 0.3 to 1 meter. Tried without load it reached a speed of 25.5 knots, and, with a 3-ton load, 24 knots. The boat was propelled by three benzine motors of a total of 300 horsepower, working three shafts at a speed of 1000 revolutions per minute. The outer machines have eight cylinders, and the middle motor, four. The former can be used only for going ahead, but by means of a reversing gear the boat can be run astern on the middle motor.

The general introduction of this type of torpedo boat would get back to the original design in the introduction of the torpedo arm into naval service. This was to put in service large fleets of small but very swift boats, offering the smallest possible target area and armed only with torpedoes, which were to attack hostile ships in great numbers. But the size of torpedo-boats has steadily increased until now they resemble small cruisers and are rarely under 50 meters long and of a displacement of 500 tons.

The great advantage of the motor torpedo-boat is its small weight of only eight tons. It is therefore possible to transport it by rail, an advantage which might be of the utmost importance in time of war in providing a harbor, attacked from the sea, with new and important means of defense.

In 1905 ten motor torpedo-boats were built in America for the Russian Navy, after designs by Mr. Lewis Nixon. These were somewhat larger than the Yarrow model, but still light enough enough for transportation by rail. On the other hand their speed, of 20 knots, was considerably smaller than that of the former model. These boats are 27.43 meters long, 3.35 meters wide, and draw 1.2 meters of water with a load of 34 tons. The weight of motors and fuel amounts to 15.5 tons, and with this amount of fuel they have a sphere of action at full speed of 400 knots. The small American torpedo-boats built for similar speed have a displacement of 51 tons and a sphere of action of from 100 to 160 knots. The Nixon boats are propelled by two six-cylinder benzine motors working on two shafts and reversed by means of compressed air. The armament consists of a deck torpedo tube for torpedoes of 450 millimeters diameter, a 4.7-centimeter quick-firing gun, and several machine guns. These boats are very seaworthy, as was shown by a voyage made by one of them under its own power from New York to the Black Sea during fairly rough weather.

A boat similar in construction to the Yarrow model but somewhat smaller has been built by Fiat-Muggiano for the Italian Navy. It was designed as a torpedo-armed auxiliary for warships, but may be applied to similar service as the British boat, though its speed is only 15 knots. This vessel is 13 meters long and 3 meters wide. It is propelled by two benzine motors of a combined power of 200 horsepower, working on the same shaft and started and reversed by compressed air. The total weight of the vessel, including machinery, is 7 tons. Fuel for an 180-knot voyage can be carried in tanks arranged forward and at the sides. The armament consists of two 356-millimeter torpedo tubes, a 47-centimeter quick-firing gun and two machine guns. A later boat built by the same firm was 11 meters long and had a displacement of 5 tons. It was driven by two 60-horsepower motors on the same shaft and reached a speed of 17 knots. For tenders the Italian Navy uses motor boats almost exclusively. The vessels built for this purpose by Fiat-Muggiano are 8.5 meters long, 2.35 meters wide and 0.58 meters draft. The displacement with a crew of 16 men and 200 kilogrammes of fuel is 3.2 tons. For the service for which these boats are designed an average speed of 8.5 knots is sufficient and this can be maintained by a 20-horsepower motor. At this speed enough fuel for a 24-hour run can be carried.

Although the German Navy has as yet built no motor torpedo-boats, several vessels propelled by internal-combustion engines have been placed in various services and the question of their general introduction is being considered. In 1903 the Daimler Company built a small vessel for general service in the torpedo department of the Kiel navy yard. This boat was propelled by an 8-horsepower petroleum motor which was the first motor using this fuel to have electric ignition and to be started by benzine. Since that time many other boats have been built for use in the navy, nearly all of them using petroleum as fuel owing to the much higher price of benzine.

Probably the most important motor boat employed in the German Navy was built by the Daimler Company for torpedo testing at Kiel and is used also for short voyages by the higher officers of the fleet. This boat is 17.7 meters long and 2.40 meters beam, and the immersion of the screw with 7 tons displacement is 1 meter. The metacentric height with 600 kilograms of fuel and a crew of six men is 450 millimeters. The boat is propelled by a 300-horsepower, 6-cylinder motor which is located amidships. To the rear of the engine room is placed a fuel tank with a capacity of 750 liters. This amount of fuel is sufficient for a 6-hour voyage, but for longer trips other tanks can be carried easily. The fuel is ordinary lamp oil and the consumption is roughly 0.32 kilogram per horsepower hour. The speed of the mator is from 800 to 900 revolutions per minute. In spite of the high power of the motor it is reversed by a hand-operated reversing clutch. The starting is also by hand, the fuel being drawn through the carbureter into the cylinder by a small hand pump. The average speed attained is 19 knots.—*Engineering Magazine.*

PRACTICAL STEAM ENGINEERING.

TWENTY-ONE DAYS IN THE ENGINE ROOM.

Compiled by LIEUTENANT PAUL FOLEY, U. S. Navy.

During the summer practice cruise of 1907, on board the U. S. S. *Arkansas*, there was evolved a course in practical steam engineering, which produced such happy results that the author feels encouraged to present it in the pages of the PROCEEDINGS, in the hope that it may be of some assistance to those still wrestling with the problem of acquiring that knowledge of, and familiarity with details, that alone distinguishes the practical engineer officer from his theoretical brother.

The course herein outlined is by no means complete in itself. At some future time it is hoped to make it more exhaustive, but it is confidently believed that a very cursory examination will convince anyone that this system as a system of instruction is immeasurably superior to the note book and lecture system of old, and that even as it stands it will carry a beginner very far along the road that ends in practical information.

FIRST DAY.

CYLINDER ATTACHMENTS AND FITTINGS.

Read Barton,* pages 131 and 142.

Cylinder Jackets.

(a) From what point is the jacket steam taken?
(b) What pressure is carried in each jacket?
(c) How is the reduction of pressure in the intermediate, and low pressure jackets obtained?
(d) How is the excess of pressure in each jacket provided against?
(e) To what place do the jacket drains discharge, and how?

Cylinder Drains.

(a) To what point on cylinders are they led?
(b) How are they operated?
(c) To what point do they discharge?
(d) Note the use, and location of the non-return valve in the bilge discharge.
(e) Note position of dial thermometer.

Cylinder Relief Valves.

(a) How are they fitted, how are they loaded, and to what point do they discharge?

Indicator Gear.

(a) How is the stroke of the engine reduced for indicator use?
(b) How many valves are there on the indicator stand pipe, and what are they used for?

SECOND DAY.

THE STEVENSON LINK.

Read Barton, pages 94, 95, and 98 to 102 bottom.

In the examination of this link motion, turn steam on the reversing engine, and move links back and forth until you are thoroughly familiar with the gear.

Note carefully the following points:

(a) The point of suspension.
(b) The method of securing the eccentric rods to the link.
(c) The method of securing the suspension rods to the link.
(d) The reference marks on the side of the independent cut-off blocks, and their meaning.

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* Barton's Naval Engines and Machinery, published by the U. S. Naval Institute.

(e) How links are always in full gear when going astern.
(f) Note how the twin valve stems of the intermediate cylinder are controlled by one link.
(g) Note the difference in shape between the forked end of the go-ahead and backing eccentrics.
(h) Note how linking up reduces the travel of the valve.

THIRD DAY.

WATER SERVICE, MAIN ENGINES.

Note:
(a) How supply may be obtained by gravity.
(b) How it may be augmented by pump.
(c) How circulating water is sent to slides, main bearings, and thrust bearings.
(d) Where this water discharges to.

Read Barton, page 508, Navy Regulations, in regard to use of water on bearings (3 requirements).

OIL SERVICE, MAIN ENGINES.

1. The various parts of a marine engine to which oil must be supplied may be divided into three classes:
(a) Stationary parts.
(b) Parts moving in a straight line, as slippers, and wrist pins.
(c) Rotating parts, as cranks and eccentrics.
2. Start at top of engine and work down, noting the following:
(d) Arrangement of reservoirs, and pipes leading therefrom.
(e) Arrangement of wicks: How rigged, material of which made, and disposition of same when engines are idle.
(f) Follow lead of oil pipes to:
Slides.
Cross-heads.
Down connecting rods to cranks.
(g) Note the position, and rig of oil cups, the hair used in them, and the wires preventing egress.
(h) Follow the lead of oil pipes to eccentrics: This arrangement being what is known as telescopic oil gear.
3. Having finished with the above, look at stationary oil cups for main bearings, and cups for links.
4. Look over oiling system of circulating pumps.
5. Read Barton, pages 507, 508, Navy Regulations, Art. 1606, par. 6, 7; Art. 1609, par. 5.

FOURTH DAY.

STEAM REVERSING ENGINE.

1. Read Barton, pages 102, 103, and 104.
2. Turn steam on reversing engine, and find the two instantaneous centers for this vessel.
3. Note the two lines by which steam may be sent to the reversing engine.
4. Note carefully how the oil hand pump is connected to the oil cushion cylinder.
5. Go carefully over the details of reversing by hand, noting that in any case it is necessary to move reversing lever to proper position.

SPECIAL VALVES.

6. Throttle valve: Page 45, Barton, Fig. 7. Examine carefully the spindle "G" in that figure. This spindle, fitted on this ship, is known as the "choke," or "gag."
7. Bleeder valves: Position with reference to separator: Use in warming up main engines to drain the main steam line. How many valves on bleeder line.
8. By-passes to receivers: Location; use in starting; use for admitting live steam to receivers under way.

9. Spring loaded valve auxiliary condenser:

SPRING LOADED VALVE, AUXILIARY CONDENSER.

The purpose of this valve is to regulate the pressure in the auxiliary exhaust line.

If there were no valve, the auxiliary exhaust line would of course be under the same vacuum shown by the auxiliary condenser.

In order to make the feed water heaters, which take their steam from the auxiliary exhaust line function, it is necessary that there be a pressure above atmosphere in the auxiliary exhaust line.

This back pressure may be obtained by means of this spring loaded valve. When the pressure in the line exceeds that for which the spring is set, the valve lifts, and the pressure is relieved into the condenser.

When the main engines are running, and the auxiliary condenser shut down, back pressure in the auxiliary exhaust line can be obtained by turning this exhaust into the low pressure receiver of the main engines, the pressure in this receiver being ordinarily about 3 or 4 pounds above atmosphere. The entire auxiliary exhaust line will then be under whatever pressure there is in the low pressure receiver.

This method is not as reliable as the first, on account of the fluctuations of pressure. It gives a back pressure, but not a steady pressure.

The introduction of back pressure above atmosphere in this line interferes somewhat with the running of the dynamo engines, when they exhaust into the same line. A small pressure makes little difference, but it should not be carried above 6 pounds, when the dynamos exhaust into the same line.

It is essential that it be clearly understood how it is possible to have a line under pressure above atmosphere delivering into a condenser under pressure below atmosphere, without impairing this vacuum.

FIFTH DAY.

U. S. S. ARKANSAS, ENGINEER DIVISION.

MAIN CONDENSERS.

Connections.

Note:

(a) Main exhaust pipe. Is there a valve between the low pressure cylinder and the condenser? If not, what is done with this inlet when the condenser is tested under pressure?
(b) Auxiliary exhaust connection. Is there a valve?
(c) Bleeder pipe connection.
(d) Cylinder and evaporator drains. Are heater drains connected?
(e) Boiling out connection.
(f) Connection of balance piston, low pressure cylinders.

Attachments.

(a) Vacuum gage. Why is it graduated in inches?
(b) Mercurial gage. Location and purpose.
(c) Air cock.
(d) Spring safety valve.
(e) Drain cocks.
(f) Location of soda tank, and detailed method of injecting soda or kerosene into each condenser.
(g) What is the atmospheric exhaust, and when is it used?
(h) Read Barton, page 508, Art. 1608, Navy Regulations, par. 1, 2.
(k) How and where is make-up feed introduced into the system?

Memorandum.

At various points throughout the department dial thermometers are fitted. These thermometers are constructed upon the difference of coefficient of expansion of two metals, usually copper and tin. They are unreliable.

SIXTH DAY.

U. S. S. ARKANSAS, ENGINEER DIVISION.

MAIN AIR PUMPS.

Read Barton, page 179, carefully.
Note:

(a) Position of pump with reference to condenser. When possible, the air pump should be so placed that the foot valves are below the level of the bottom of the condenser.
(b) Note construction of rocker driving arm.
(c) Note how the oscillating motion of this driving arm is transferred to the straight line motion of the plunger rod by means of connecting links.
(d) Thermometer on top of pump. What is it for?
(e) Note drains for head plate and bucket.
(f) Are these air pumps single or double acting?
(g) Of what material are the following parts made:
Barrel.
Plunger rod.
Bucket.
Valves.
(h) What is a regurgitating valve, and what is it used for?
(k) Read Barton, page 508, Navy Regulations, Art. 1608, par. 4, 6.

CHANNEL WAY PUMP.

The function of this pump is simply to relieve the air pump suction of entrained water, and at the same time to maintain a low vacuum when the main condensers are in use, with the main engines stopped.

SEVENTH DAY.

U. S. S. ARKANSAS, JULY 5, 1907.

MAIN CIRCULATING PUMPS.

Read Barton, pages 187, 188, 189.
Note:

(a) Location of main injection valve.
(b) Location of adjacent suctions to main drain, and bilge, with interlocking device.
(c) Note steam pipe, leading from auxiliary steam line to injection pipe, outside of valve. What is it used for?
(d) Why is a by-pass fitted between the main injection, and discharge pipes, and when is it used?
(e) Does injection water enter at upper or lower half of condenser? Why?
(f) Is there any other pump in this engine room that could be used to flush the condenser in case the main circulating pump is disabled?
(g) Will one circulating pump flush both condensers?
(h) Is the engine driving circulating pumps a compound engine? If not, what is it?
(k) How and where do you obtain the temperature of circulating and discharge water on this ship?
(l) What is the side injection, and when is it used?

EIGHTH DAY.

FEED AND FILTER TANKS.

Read Barton, page 185.
Note:

(a) Point to which the delivery of the main air and channel way pumps is led. Is there a valve near tank?
(b) Is there a vapor pipe? What is it used for?

(c) Where is the overflow pipe? Where does it lead? Note that it is located so as to be visible from the working platform.
(d) Note the spring-loaded relief valve.
(e) Location of gage glasses.
(f) How and where is the temperature of feed water obtained?
(g) The various feed pump suctions are severally tapped either into the feed tank proper, or more frequently, as in this ship, are tapped into a cross-connecting pipe between the two feed tanks. This pipe is fitted at each tank with a valve operated by a copper float. When the water level in the feed tank falls below float, the valve closes, and prevents air being sucked by pumps. The levers by which these floats are controlled are visible from the outside.
(h) Are there any valves in cross-connecting pipe?
(k) Note the connections for drainage from separators, main and auxiliary steam pipes.
(l) Where is the inlet placed with reference to the ordinary working level?
(m) Does this connection lead to feed tank proper, or to filter tank?
(n) Why are the *cylinder, evaporator,* and *heater* drains led to the *condenser,* while those from the steam pipes, jackets, and separators are led to the feed tanks?
(o) What filtering material is used in this vessel?
(p) Observe that the bottom of the feed tank is above the water end of all the feed pumps.

NINTH DAY.

PREPARATIONS FOR GETTING UNDER-WAY.

ENGINE ROOM.

In connection with the blue print of the piping system in the log room, and supposing that boiler *C* is in use for auxiliary purposes, find out:

(a) What valves on the main steam line are open, and what valves are closed. Every valve must be accounted for, 13 in all.
(b) Assuming that fires are to be lighted in boilers *A, B,* and *D,* and that the main engines are to be warmed up with these boilers, what changes will be made in what valves, and how many turns will be given to the spindle of each valve?
(c) Disconnect jacking gear. How is it done?
(d) Open main injection and discharge valves. See that by-pass is closed.
(e) Start main circulating pumps. Locate drains, steam, and exhaust valves.
(f) Drain main steam line. Locate two drains in evaporator room on each side, and one in engine room on each side. Open separator drains.
(g) Steam on the reversing engine, using steam from the auxiliary line.
(h) Open cylinder drains.
(k) Open valve to jacket line. Open jacket drains.
(l) Water on water service pipe, where? When put water on slides thrust and main bearings?
(m) Slack stern gland. Where, and how much, and why?

Read Barton, pages 457, 458, and 459.

Memorandum.

There are two separate and distinct methods of warming up the main engines and the main steam line, and it is essential that they should not be confused. The two methods are the ordinary and the emergency.

ORDINARY METHOD.

The ordinary method is to warm up the engines and the main steam line by means of the boilers in which steam is being raised. In this method the boiler stops of the new boilers are cracked as soon as fires are lighted, and every other valve on the main steam line and jacket line opened wide, allowing the hot air, and subsequently steam, to flow through. When the steam is up to the working pressure, the auxiliary boilers that have been in use all the time are connected up to the new boilers.

EMERGENCY METHOD.

The emergency method is to warm the steam line and main engines by means of the boilers already in use. The stops of the new boilers are kept closed, and as the pressure comes up, each in turn is connected to those already on, until finally the whole system is connected up.

TENTH DAY.

U. S. S. ARKANSAS, JULY 7, 1907.

FEED WATER HEATERS.

Read Barton, page 344.

The economy and increased efficiency of boiler plant resulting from the use of feed water heaters is very great. The following facts in connection with them should be well digested.

(a) That the saving is obtained by causing the latent heat of the auxiliary exhaust steam to heat the feed water, instead of allowing the circulating water of the condenser to take the heat away.

(b) That the temperature of feed that can be obtained with any given heater depends solely upon the pressure in the auxiliary exhaust line, and varies with that pressure. The temperature of feed water obtained must necessarily be somewhat less than the temperature of the steam used to heat it.

(c) An efficient heater will give a temperature within 10 degrees of the temperature of the steam.

(d) In connection with the subject of the temperature corresponding to pressure, see Barton, Steam Tables, page 520. For example, note that the temperature of an auxiliary exhaust line attached to a condenser showing 16 inches vacuum, or 7 pounds back pressure (absolute) would be 177 degrees. Also that the boiling point of water under 225 pounds pressure, 240 absolute, would be about 400 degrees. In dealing with ships' plants, it is necessary to get away from the 212 degree idea in connection with the boiling point of water.

(e) A pressure of about 5 pounds above atmosphere, 20 pounds absolute, will give a feed temperature of about 220 degrees.

(g) Temperatures above 212 degrees can only be recorded by dial, or some form of attached thermometer. When the feed line is tapped, the maximum temperature that will be recorded will be 212 degrees.

(h) Heaters may be either suction or pressure heaters, and both may be either vertical or horizontal.

(k) The preferred type is the closed, vertical, pressure heater, similar to that installed on this vessel.

(l) In this type the feed water goes through the tubes, and the exhaust steam outside the tubes. In the heaters installed in this vessel there are about 200 tubes in each heater, of similar size, and material to condenser tubes, and inserted in tube sheets in a similar manner.

(m) To secure the highest temperature the heater must be so arranged that the hottest water strikes the hottest steam—that is that the steam should enter the heater at the top, and be made to flow across the tubes by means of horizontal baffles.

(n) The water should enter at the bottom, and discharge at the top to ensure heater always being full.
(o) Both main and auxiliary feed lines are connected to heater by suitable by-passes.
(p) Heater drains are led direct to the condenser or feed tanks. In this vessel there is a trap.
(q) Note gage glass and steam gage.
(r) Note that there are two heaters, one on each side.

ELEVENTH DAY.

MAIN FEED PUMPS.

Read Barton, page 338.

Main feed pumps have fresh water connections only. They draw from the feed tanks and reserve feed tanks, and discharge to the main feed line, through the heater, or by the heater as desired; and to the reserve feed tanks, the delivery pipe to the reserve feed tanks being a branch of the main feed pipe with a valve in it.

Find out:

(a) The number, location, and make of the main feed pumps of this vessel.
(b) Locate the maker's name plate on pump, and read it carefully. This data is sufficient to identify pump, and secure new parts.
(c) Locate steam and exhaust pipes of steam end, and cylinder drains.
(d) Locate pressure gage for steam end.

Water End.

(a) Is it a single or double acting pump?
(b) Locate suction from feed tanks and suction from reserve feed tanks.
(c) Are there any valves on suctions other than those at the pump?
(d) Locate discharge to the main feed line direct, and discharge through heater.
(e) Locate discharge to the reserve feed tanks.
(f) Locate spring relief valves. Where do they discharge to?
(g) How many air chambers are there, and where are they placed?
(h) Are the air chambers fitted with cocks at the top, and if so, what are they used for?
(k) Locate pressure gage for discharge end of pump.
(l) What is the pet cock on the top of water chamber for?
(m) How are the head valves of the water chamber drained?
(n) Is there a blank flange connection, and if so, why?
(o) Why are pump gages graduated to record pressures considerably in excess of the designed working pressure of the boiler?
(p) When a pump is not in operation, the cylinder drains should be kept closed, why?

Read Barton, page 509, Art. Government Navy, 1608, par. 7.

TWELFTH DAY.

MAIN FEED LINE.

Read Barton, pages 194, 195.

(a) Follow the lead of each main feed pump to the boilers on its own side.
(b) Are the two main feed pipes cross-connected, and if so, where?
(c) How many valves are there on each boiler between the steam drum and feed pipe, and what is each called? (See Bieg, pages 105 and 106.
(d) Why is a stop valve placed between the boiler and the check?
(e) Note carefully how the flange of the feed stop is made fast to the steam drum.

(f) When steaming with all boilers in use on this vessel, from what point is the feed for each boiler controlled, and what is the condition of the two valves at the steam drum?
(g) Will one feed pump feed four boilers?
(h) Are there any other pumps in the ship connected to the main feed line?
(k) Note that all feed pipes are as far as possible carried above the floor plates.
(l) Cut-out valves in feed lines are in most cases gate valves, to give a clear run and reduce friction.
(m) All copper pipes intended to convey salt water are coated on the inside with some form of water proof varnish, applied hot.

THIRTEENTH DAY.

AUXILIARY FEED PUMPS; AUXILIARY FEED LINE.

Auxiliary feed pumps differ from main feed pumps in two ways: (1) in capacity; (2) in that they have both fresh and salt water connections, as follows:

Fresh Water Connections.

Suctions:
1. From cross-connecting pipe of feed tanks.
2. From bottom blows of the boilers in the same compartment, or on the same side of the ship.

Discharge:
1. To boilers through the auxiliary feed line only.
2. Overboard.

Observe that the auxiliary feed pumps are not connected to the reserve feed tanks, in order to avoid the danger of salting that water.

Salt Water Connections.

Suctions:
1. Sea.
2. Auxiliary drain manifolds.
3. Main drain.
4. Engine and fire room bilges.
5. Hose nozzle for attaching suction hose.

Discharge:
1. To boilers, through the auxiliary feed line. (Salt feed to boilers).
2. Fire main.
3. Distiller circulating pipes and flushing main.
4. Overboard.
5. Hose nozzle at pump.

The practice of fitting auxiliary feed pumps with both salt and fresh water connections is one of necessity rather than of choice.

The multiplicity of salt water connections for each pump is obtained by connecting each pump to a manifold, all the connections of the manifold becoming connections of the pump. While the connections may appear complicated at first sight, careful study of those of one pump, will make the principles of the piping system perfectly clear.

Find out the following:
(a) Location of manifolds and all connections outlined on preceding page, with valves controlling each.
(b) Open Macomb strainer, and find out how the basket is fitted.
Note: About one-half the Midshipmen, on final examination, get the basket upside down.

AUXILIARY FEED LINE.

The connections from the auxiliary feed pumps merge into the auxiliary feed line on the forward engine room bulkhead. From this point the auxiliary feed line is carried forward on the center line of the ship. The connections to each boiler in the fire room are very simple.

FOURTEENTH DAY.

EVAPORATORS AND DISTILLERS.

Read Barton, pages 347 to 352, inclusive.

Locate the following attachments:

(a) Safety valve, one for shell and one for coil.
(b) Steam gage for coil.
(c) Combined steam and vacuum gage for shell. A gage recording pressures above and below atmosphere is called a compound gage.
(d) Reducing valve for coil.
(e) Salinometer pot.
(f) Feed check valve.
(g) Discharge to vapor pipe.
(h) Bottom blow.

Primary Steam.

In the case of the evaporators installed on this vessel, the primary steam is taken from one place only:

(a) The auxiliary steam line, a proper reducing valve being fitted.

The water of condensation is trapped to the condensers, there being a connection to the trap to send steam to the distiller fresh water pump. (Not in this vessel.)

Secondary Steam.

The sources of supply of secondary steam are as follows:

(a) As salt water from sea direct, by means of the evaporator feed pump.
(b) By gravity from the distiller circulating water dicharge. (Usual practice, warmer water being obtained this way). Note: This feed may be urged by evaporator feed pump.

The brine accumulating at the bottom of the evaporator may be disposed of in two ways:

(a) By blowing down to the bilge in this vessel—more generally to a pipe leading overboard.
(b) By pumping down by means of a brine pump, in which case the brine is discharged to the distiller circulating water discharge, well beyond the point from which feed is taken, and sometimes to the sea direct. Brine pumps are not generally used.

The vapor formed by the evaporation of the salt water is discharged through the vapor pipe to:

(a) Auxiliary exhaust line. (Bad practice.)
(b) Feed tanks. (Good practice.)
(c) Reserve feed tanks.
(d) Ship's fresh drinking water tanks.

Discharges (a) and (b) are direct; (c) and (d) indirect.

In the case of the port evaporator only, the vapor may also be delivered as:

(e) Primary steam to the starboard evaporator, to permit working the evaporators in double effect.

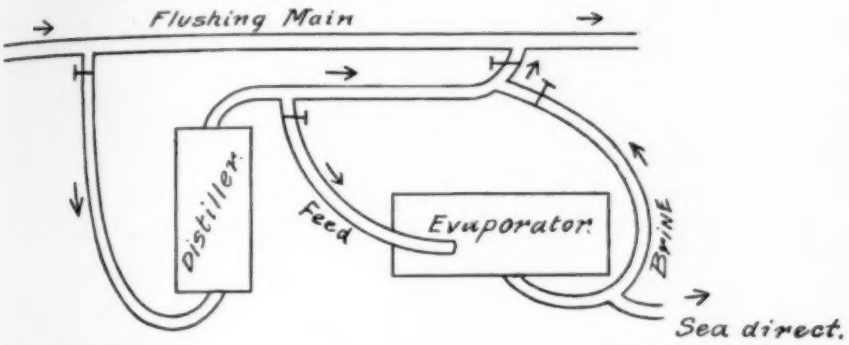
DISTILLERS.

The vapor of evaporation, secondary steam, is almost always discharged through the distillers, where it is condensed and cooled by the salt water circulating through it.

Distiller Circulating Pump.

The distiller circulating water is a loop from the flushing main. Any pump on the flushing system may be used to circulate water through the distillers. The circulating water enters at the bottom, and discharges at the top.

The evaporator feed is a loop on the discharge side of the distiller loop, as given in the following line sketch:



The fresh water condensed in the distiller accumulates in a reservoir tank below, the reservoir being fitted with filtering material and a gage glass.

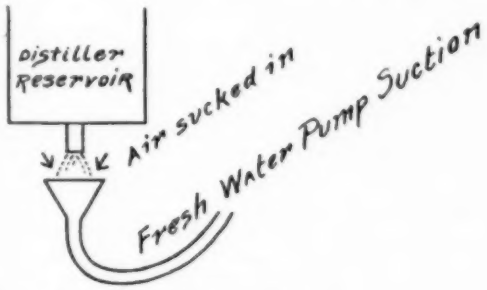
From this reservoir it is pumped by means of the distiller fresh water pump, to any one of the following places:

(a) Bilge. (For use when the water is salt.)
(b) Fresh water tanks.
(c) Reserve feed tanks. (By gravity on this vessel.)

The distiller fresh water pump takes its steam.

(a) From auxiliary steam line.
(b) From trap of primary steam,—this to prevent evaporators from becoming air bound.

When discharged into the fresh water tanks, the water is still not potable until it has been aerated. Aeration is accomplished by means of air pipes fitted to the tanks. A more efficient way is to fit a connection at the bottom of the reservoir tank as given in the line sketch below.



Read Barton, page 509, Art. 1608, par. 8, 9, 10.

FIFTEENTH DAY.

EVAPORATORS AND DISTILLERS.

Operation.

In starting up the evaporators through the distillers, the following procedure will be observed:

(a) Open distiller circulating water supply and discharge valves.
(b) Open evaporator feed and fill evaporator to about one-half glass, level of the third row of tubes.

(c) Open steam to steam coils.
(d) Open coil drain connections to steam traps.
(e) Allow pressure on coils to come up to about 20 pounds per gage.
(f) When steam pressure in shell is 10 pounds, crack vapor valve to distiller and gradually open it so as to keep about 5 pounds pressure on the shell.
(g) Regulate the feed check to keep the water at a constant level.
(k) Open discharge from distiller reservoir to bilge until water is known to be fresh.
(l) Start distiller fresh water pump.
(m) Open distiller discharge to point desired.

In shutting down the following procedure will be followed:
(a) Open bottom blow and blow down well.
(b) Close evaporator feed.
(c) Shut off primary steam.
(d) Close down the distiller fresh water pump.
(e) Shut off distiller circulating water.

Midshipmen in charge of watches will not initial this sheet as completed until each member of their respective watches has done each of the operations outlined below. The starboard evaporator will be used for this purpose, and the sheet will be worked through during the first port watch.

Start evaporator on:
(a) Ship's tanks.
(b) Reserve feed tanks.
(c) Discharge without distiller to feed tanks.

Owing to the damaged condition of the port evaporator it is impracticable to operate the evaporators in double effect.

SIXTEENTH DAY.

Main Boilers.

The boilers installed on this vessel are of the type known as the Schulz-Thornycroft. The type as installed in this vessel is now exclusively installed in all vesses of the Imperial German Navy.

Read Bieg, pages 252, 253, and 265.

When sketching any of the small tube boilers, it is helpful to remember:
(a) That they are practically equilateral triangles.
(b) That the grate level is either at the center or at the bottom of the wing drums.

Find out on these boilers the following:
(a) Location of safety valves. Star duplex safety valves used here. See Bieg, pages 118, 121, and 123.
(b) Where do safety valves discharge?
(c) Arrangement of safety valve easing gear. Bieg, page 124. In this vessel the spindle is vertical.
(d) Sentinel valves. Location and area; where discharge? See Bieg, page 125.
(e) Foster stop valve. See Bieg, page 165.
(f) Why is escape pipe fitted with a bell mouth.
(g) Position of steam gage and connections to the boiler; syphon at the bottom. See Bieg, page 165. Syphons must be so arranged that:
  (a) They contain water enough to fill both springs when under pressure.
  (b) So fitted that the water seal will not be drawn out of syphon when the pressure is off.
  (c) A cock between syphon, and gage.
(h) Dynamo stop. See Bieg, page 134.
(k) Position of surface blow valve. Where does it lead and where discharge? See Bieg, page 134.
(l) Bottom blow from each drum. How open the circulation to the auxiliary feed pumps in the engine room?

(m) How are the bottom blows of the four boilers connected? See Bieg, page 135.
(n) Position of air cock.
(o) Location of gage glasses. See Bieg, page 111.
(p) Location and use of salinometer pots. See Bieg, page 139.
(q) Position of gage cocks: where do they discharge, and how?
(r) Fitting of manhole plates. See Bieg, page 142.
(s) Air pressure gages. See Bieg, page 71.
(t) How is gage graduated?
(u) To what points is each of the legs connected?
(v) Fire extinguishers to bunkers. What line are these pipes on?
(w) How get soda into these boilers, and where?
(x) Furnace door frames. See Bieg, page 19. Why is the axis inclined to the vertical? How is the door kept open when the ship is rolling? Of what material are furnace door liners made? How is air admitted above the grate?

SEVENTEENTH DAY.

CARE AND OPERATION OF BOILERS—PRESERVATION.

(1) Read Barton, pages 452 to 457; 459 to 466, and 473 to 477, covering the following sub-heads:
(a) Raising steam.
(b) Control of steam.
(c) Standing by.
(d) Banked fires.
(e) Management of fires underway.
(f) Firing a furnace.
(g) Cleaning fires.
(h) Sweeping of blowing tubes.
(k) Routine of watch at sea.
(l) Starting an additional boiler.
(m) Disconnecting a boiler.
(n) Preparations for port.
(o) Surplus feed water.
(p) Loss of feed water.
(q) Renewing grate bars.
(r) Burst gage glass. Find out by inspection of gage glasses in store room why a 5/8-inch glass is actually stronger than a 3/4-inch glass.
(s) Low water.
(t) Feed pump inoperative.
(u) Priming.

Read Barton, pages 508, and following: U. S. Naval Regulations in regard to the following:
(1) Reports on condition. Art. 1609, par. 1.
(2) Periodical examinations. Art. 1614.
(3) Drill tests. Art. 1612, par. 5; Art. 1615.
(4) Hydraulic test. Art. 1612.
(5) Record of tests. Art. 1613.
(6) Distribution of work. Art. 1609, par. 31.
(7) Services of deck force as coal passers, and firemen. Art. 1197.
(8) Increasing speed. (Does not apply to water tube boilers). Art. 1609, par. 27.
(9) Changes in temperature. Art. 1609, par. 17.
(10) Coal in fire rooms. Art. 1609, par. 33.
(11) Connection doors. Art. 1609, par. 18.
(12) Record of time fires are lighted. Art. 1609, par. 20.
(13) Banked fires. Art. 1611, par. 20.
(14) Hauling fires after steaming. Art. 1609, par. 21.
(15) Dry pipes and drains. Art. 1609, par. 6.
(16) Priming furnaces. Art. 1609, par. 10.

(17) Lifting safety valves. Art. 1609, par. 12.
(18) Securing valves. Art. 1609, par. 11.
(19) Care of exterior. Art. 1609, par. 16.
(20) Care of uptakes. Art. 1609, par. 19.
(21) Air space in uptake. Art. 1609, par. 30.
(22) Ashes in fire-room. Art. 1609, par. 32.
(23) Care of forced draft ducts. Art. 1609, par. 34.
(24) Boiler interiors, not in use. Art. 1609, par. 7, 8.
(25) Forced draft. Art. 1603; Art. 1609, par. 26.
(26) Blowers to assist draft. Art. 1609, par. 28.
(27) Tallow or vegetable oil. Art. 1609, par. 5.
(28) Changing water. Art. 1609, par. 14.
(29) Use as tanks. Washing out. Art. 160, par. 8, 15.
(30) Acidity of water. Art. 1610, par. 10.
(31) Litmus test. Art. 1610, par. 2.
(32) Level of water line. Art. 1609, par. 9.

EIGHTEENTH DAY.

MISCELLANEOUS.

(a) What are crank trams, and for what purpose are they used?
(b) What are valve trams, and for what purpose are they used?
(c) Where are the reference marks for crank trams and for valve trams?
(d) What are smothering valves and for what purpose are they used? How many valves are there on each line?
(e) What are air locks, and for what purpose are they used?
(f) How are the coal bunkers ventilated. See Bieg, page 61.
(g) What are the air escapes from the double bottom reserve feed tanks? Where are they placed, and are there any valves on each pipe?
(h) What and where are the sounding pipes to the double bottom reserve feed tanks.
(k) How is the quantity of water in the double bottom reserve feed tanks measured? See Barton, page 509, Art. 1608, par. 3.
(l) How is fresh water conveyed from a water barge to the reserve feed tanks of this vessel? What pumps may be used for this purpose?
(m) Where are zinc protectors placed on all copper suction and discharge pipes intended to convey salt water? See Barton, page 195. Examine one of these boxes on this ship.
(n) Do the armor bars extend across the interior of the smoke pipe?
(o) Each watch will take the saturation of the water in the auxiliary boiler, using the salinometer pot.

NINETEENTH DAY.

AUXILIARY STEAM AND EXHAUST PIPING.

The auxiliary steam pipe extends throughout the length of the boiler and engine room compartments, with branches leading forward and aft. It is the only one of the main arteries of the ship that has a return lead.

In the latest practice, as in this ship, the auxiliary steam pipe takes steam from the nozzle at the cross-connection between the main steam pipes in the engine room, there being a reducing valve between the auxiliary stop, and the line stop of the main steam line on each side.

The auxiliary steam pipe is made of lap-welded mild steel.

The auxiliary exhaust pipe is made of seamless drawn copper.

Auxiliary Steam Pipe.

(a) It is so arranged that steam condensing into it is drained back into the separator.
(b) Wherever pockets occur, the pipe is drained and trapped.
(c) All branches from the main pipe to pumps on a lower level have a stop valve close to the main line, to prevent water condensing in the vertical pipes.

(d) All branches to auxiliary machinery outside of the machinery spaces have stop valves in the engine or fire rooms.
(e) All branches leading to crank engines, such as the main circulating pumps, anchor engine, or steering engine are led from the top or side, never from the bottom of the pipe.
(f) All branches leading to *direct driven pumps* are led from the *bottom* of the pipe.

Auxiliary Exhaust Pipe.

(a) It is fitted with valves to direct the exhaust into any one of the following places:
(1) Either main condenser.
(2) The auxiliary condenser.
(3) Either low pressure receiver.
(4) Into either feed water heater.
(5) Into atmosphere through the escape pipe.
(b) At each connection with the condensers and the escape pipe, the pipe is fitted with two stop valves to minimize the chances of an air leak.
(c) All branches leading to machinery on a lower level are fitted with stops close to the main pipe.
(d) Connection with the escape pipe will be made below the armored deck.
(e) All exhaust pipes from engines above the armored deck are fitted with valves below the armored deck.
(f) The dynamo engines exhaust are so led that one engine cannot exhaust into another, or an engine not in use flooded. This is accomplished by means of swing check valves close to the valve chests of each engine.

The following connections are made to the auxiliary steam pipe.
(a) Anchor engine.
(b) Whistle, siren.
(c) Steam to shower baths.
(d) Pantries.
(e) Crews head.
(f) Deck winches.
(g) Steering engine.
(h) Main and auxiliary condensers for boiling out.
(k) A one-inch steam pipe to each sea suction, out board of the valve. Used for freeing the strainer of marine growth after the vessel has been in warm waters.
(l) Steam for galley coppers is taken through a separate pipe, fitted with reducing valve, relief valve, and gage.

TWENTIETH DAY.

ADJUSTMENT OF LINKS.

Much of the unnecessary mystery that surrounds the subject of link adjustment can be cleared up by a little careful thought and attention directed upon the following points.

Links may be adjusted with either of two objects in view:
(a) Smooth running.
(b) Equalization of power.

Smooth Running.

Theoretically, the adjustment for equal power in the cylinders ought also to be the adjustment for smooth running of the engines, but practically such is not the case. The adjustment of the links for smooth running varies with the condition of the cross-head, and crank pin brasses, with live steam in either receiver, with any number of mechanical conditions which not only change the adjustment for each particular vessel, but may even change it also for each particular engine.

The one fact upon which adjustment for smooth running is based is this: *Linking-in reduces the travel of the valve.*

It is quite possible for the adjustment of a link for smooth running to be diametrically opposite to the adjustment of the same link for equal power. For example:

Suppose the drag links of the intermediate valve gear to be out of adjustment, and producing excessive vibrations throughout the entire reversing shaft; *linking-in* would stop the vibration, because it would reduce the travel of the valve, but that same linking-in would *increase* the work done in that cylinder.

Therefore: No intelligent adjustment of links can be made until it is first decided what the adjustment is for. Answered that question, the rest is easy.

It is simply necessary to move the links in or out until the conditions of smoothest running are obtained.

Equalization of Power.

The practical problem is this:

(a) With any given steam pressure and vacuum, what must be the gage reading on the intermediate and low pressure receiver gages in order to produce equal power in the cylinders?

(b) Having determined what the gage readings should be, how get them by altering the cut-offs.

The desired reading of the first and second receiver gages for equal power is obtained by analysis. If each cylinder is to do an equal share of work, the drop in pressure in that cylinder, multiplid by its ratio to the high pressure cylinder should be nearly equal. For example, take the case where the cylinder ratios are $1 : 2\frac{1}{3} : 6$.

With, for example, 200 pounds pressure at the throttle, and 24 inches of vacuum, the total range of pressure is from 200 pounds to 12 pounds, or 212 pounds.

Dividing this in the inverse ratio of the cylinders, we have

$$\frac{212}{9\frac{1}{3}} = 22.8 \text{ pounds.}$$

The drop in the high pressure cylinder is: $22.8 \times 6 = 137$ pounds.
The drop in the intermediate cylinder is: $22.8 \times 2\frac{1}{3} = 53$ "
The drop in the low pressure cylinder is: $22.8 \times 1 = 23$ "

Total drop ..... 213 "

That is, for the cylinders of this vessel, the power in the cylinders will be equal, for 200 pounds' pressure, when the gage readings are respectively 200, 63, and 10 above atmosphere.

On account of initial condensation, an extra allowance should be given the high pressure. Make the gage readings 200, 60, and 10 above atmosphere.

Construct a table for desired gage readings for varying steam pressures for any particular engine, using the above method, and for that engine the first part of the problem is completed.

The second part, *how to get gage readings when they are not,* is equally simple. The *intermediate,* and the *low pressure* are the only links concerned.

Linking in on either of these links *increases* the gage reading of its own cylinder.

Linking out on either of these links *decreases* the gage reading of its own cylinder.

The popular superstition that equalization of power can only be obtained by taking, and working out a set of indicator cards is only a myth. By the above method it is practicable to adjust any engine for equal power at any time, without reference to any indicator cards.

For an explanation of how linking in equalizes the power, see Barton, page 117.

High Pressure Cut-off.

The high pressure cut-off has nothing whatever to do with the distribution of work. It may, and often does, have something to do with smooth running. The function of the high pressure cut-off is solely to secure economy of running by increasing the number of expansions. (See Barton, pages 117 and 118.)

To get the greatest power with the greatest economy, the high pressure cut-off should be run in as far as possible, while at the same time using all the steam made by the boilers.

The high pressure *cut-off*, and *not* the *throttle*, should regulate the steam, for this reason:

By keeping a high pressure in the steam pipe, and *throttling*, the initial pressure is greatly reduced at the point of cut-off, the steam line of the indicator card falls, and the gain in economy due to high pressure is to a great extent lost.

By regulating with the cut-off, the initial pressure is kept up to the point of cut-off, and the steam line of the diagram becomes more nearly horizontal, as it should be.

Throttling should be resorted to only when the steam pressure in the high pressure cylinder continues to fall with the cut-off all the way in.

TWENTY-FIRST DAY.

THE SLIDE VALVE, THE INDICATOR CARD, AND THE ZEUNER VALVE DIAGRAM.

1. There can be no thorough understanding of the action of valve gears until the intimate and interchangeable relation which exists between the slide valve, the indicator card, and the Zeuner valve diagram, is thoroughly impressed upon the mind.

2. It being assumed that pages 51 to 55, 58 to 66, and 213 of Barton have been carefully studied, the following digest of facts may be made:

Of the Slide Valve.

3. An eccentric is simply a small crank which drives a slide valve. In all the Herreshoff vessels the eccentrics are replaced by small cranks.

4. A slide valve makes *one* complete stroke with each stroke of the piston, and only one, but the slide valve, and the piston start each from different points. The piston starts from the top of the cylinder, the slide valve starts, not from the top of the valve chest, but from the middle of the valve chest, plus a distance equal to the lead plus the lap.

5. The only difference between an inside and an outside valve of the same dimensions is, that the outside valve would start to move in the same direction as the piston, while the inside valve would start to move in the opposite direction. Once started each returns to the starting point once for each stroke, twice for each revolution.

Of the Zeuner Valve Diagram.

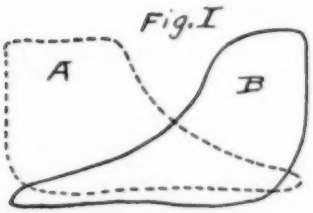
6. As the horizontal was the forerunner of the vertical engine, the line of stroke of the Zeuner Valve Diagram, *AA'*, page 64, Barton, is horizontal. The Zeuner can best be studied and understood for vertical engines, by holding page 64 horizontal, and making the point *A* the top center. The crank and eccentric are then before the eye as they appear in the engine room.

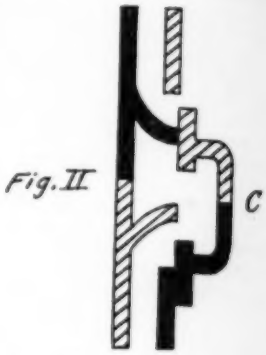
Of the Indicator Card.

7. Indicator cards must be regarded as a series of points,—admission, cut-off, release, and compression, connected by a series of lines, admission line, steam line, expansion line, exhaust line, and compression line. The shape of the card is determined *by the relative position of the points.* Errors in the position of the points make errors in the lines connecting them. The points are the cause, the lines the effect.

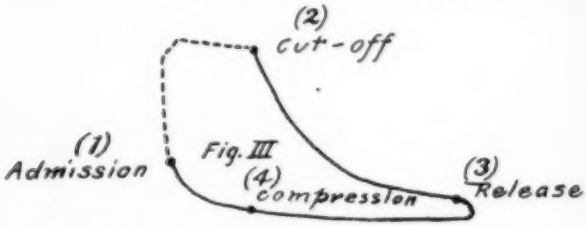
8. The indicator cards, *A* and *B*, Fig. I, are graphic representations of the work done by the slide valve, *C*, Fig. II.

9. In the following discussion, it is assumed that *C* is an outside valve, and that the card, *A*, the left hand card is the top card,—that is the card traced by the hatched end of the valve, *C*, while the black card is the bottom card, traced by the black end of the valve, *C*.

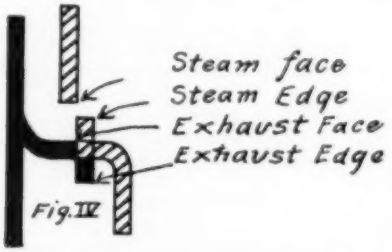




10. The left hand card of a two-card diagram is not necessarily the "top" card. It depends solely upon whether the indicator drum is on the right, or the left side of the tracing pencil, see indicators illustrated on pages 206 and 207, Barton. In the one case the left card will be the top card, and



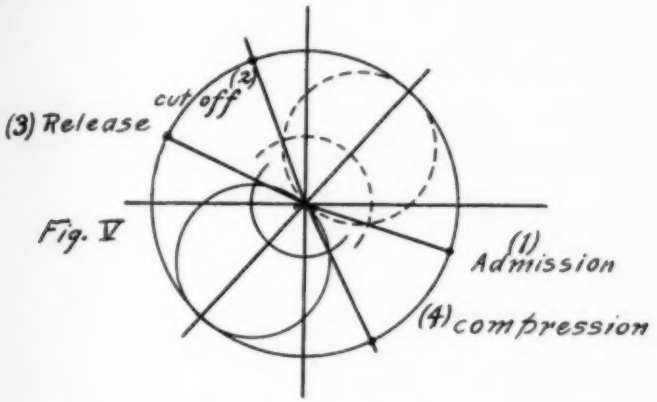
in the other the right card will be the top. The "top" card is determined practically by taking one card with the bottom indicator cock closed, and noting whether the admission line is to the right or left for that indicator on that cylinder.



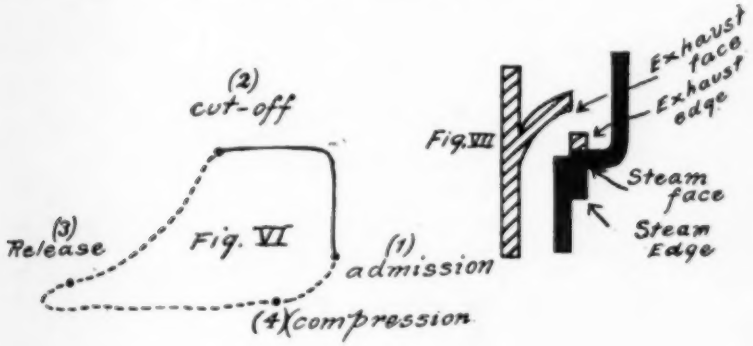
11. The dotted card of Fig. I, reproduced in Fig. III, is a series of lines drawn about the four points thereon indicated, and marked,—(1) admission, (2) cut-off, (3) release, and (4) compression.

12. Of these four points two, (1) admission, and (2) cut-off, are traced,

Fig. IV, when the *hatched edge* (steam edge), of the valve, intersects the *hatched face* (steam face) of the port,—(1) admission when the valve is going *down*, (2) cut-off when the valve is going *up*. Two, (3) release, and (4) compression, are traced when the black edge (exhaust edge), of the valve intersects the *black face* (exhaust face), of the black port,—(3) release when the valve is going *up*, and (4) compression, when the valve is going down a second time.



13. In the Zeuner Valve diagram, Fig. V, the points (1) and (2) are given by the intersection of the dotted circle, *top steam lap*, with the *top steam valve circle*, and points (3) and (4) by the intersection of the black circle, *top exhaust lap*, with the *top exhaust valve circle*.



14. The bottom card, the black card of Fig. I, reproduced in Fig. VI, is a series of lines connecting the four points thereon indicated, and marked, (1) admission, (2) cut-off, (3) release, and (4) compression.

15. Of these four points two, (1) admission, and (2) cut-off are traced, Fig. VII, when the black edge (steam edge), of the valve intersects the *black face* (steam face), of the port,—(1) when the valve is going *up*, and (2) when going down. Two, (3) release, and (4) compression are traced when the *hatched edge* (exhaust edge), intersects the *hatched face* (exhaust face), of the port. (3) When the valve is going down, and (4) when going up a second time.

16. In the Zeuner diagram, Fig. VIII, points (1) and (2) are given by the intersection of the black circle (*bottom steam lap*), with the *bottom steam valve circle*, and points (3) and (4) by the intersection of dotted circle, *bottom exhaust lap*, with the bottom *exhaust valve circle*.

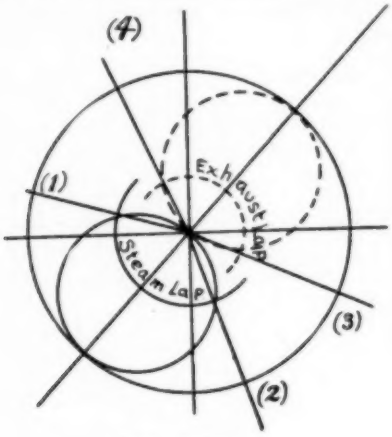
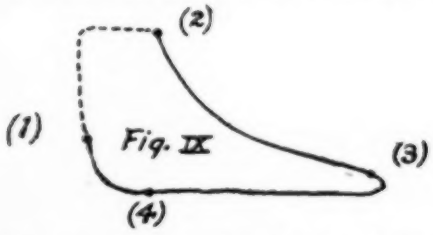
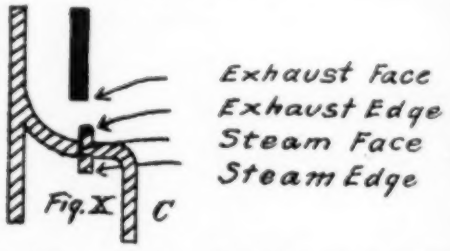


Fig. VIII

17. If *C*, Fig. II, is an inside valve, the points of the top card, reproduced in Fig. IX, as follows: The valve starts to move upward, when the piston starts downward. Points (1) and (2) are traced by the intersection of



the *hatched edge* (steam edge), of valve, *Fig. X*, with hatched edge of port (steam edge). (1) When the valve is going up, and (2) when the valve is going down. Points (3) and (4) are traced by the intersection of the



black edge (exhaust edge), of valve with the black face of port (exhaust face). (3) When the valve is going down, and (4) when it is going up a second time.

18. The Zeuner for this condition is exactly the same as Fig. V.

19. It will thus be seen that for an *inside valve*, the *steam*, and *exhaust edges* of the valve interchange, and the *steam and exhaust faces* of the port interchange; but the indicator card, and the Zeuner valve diagram do not change.

20. From the foregoing it follows that the effect of any abnormal condition in valve gear, such as excessive angle of advance, etc., upon the indicator card can be determined graphically by the Zeuner valve diagram. After a little practice, it is not even necessary to draw the Zeuner. It can be pictured mentally, and again it is necessary to repeat that the Zeuner, and the indicator card are identical for inside and outside valves, for piston valves and for slide valves, for single ported and for double ported valves.

21. For any abnormal condition, it is necessary to answer two questions:

(a) Does it affect both cards?

(b) Does it affect the four points of one or both cards? If not, how many points does it affect?

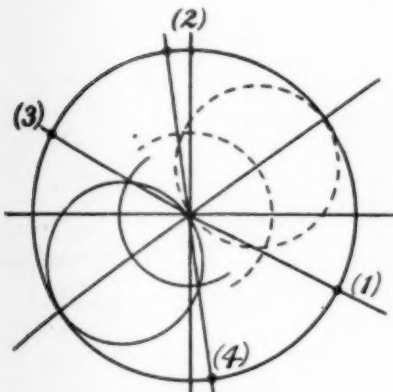
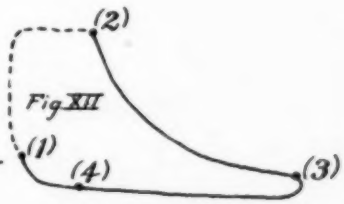
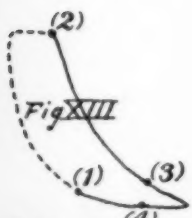


Fig. XI
Normal Zeuner



Normal Card



Abnormal Card

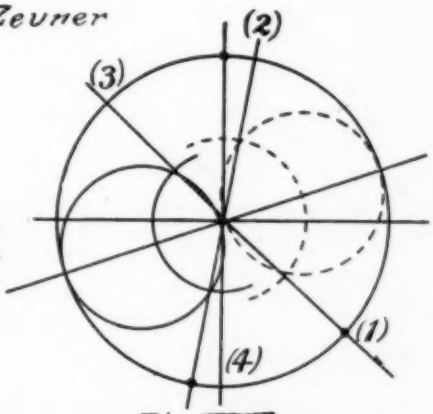


Fig. XIV
Abnormal Zeuner

22. Both are answered by the Zeuner, as the following illustrations will show:

CASE I.

Excessive Angular Advance.

(a) Affects both cards.
(b) Affects four points of each card alike.

CASE II.

Valve Stem Too Long.

(a) Affects both cards.
(b) Affects four points of each card. Two in one way, and two in another.

For the top card, outside valve, the condition is equivalent to decreasing the lead, and,—since the angle of advance remains unchanged, the lead can

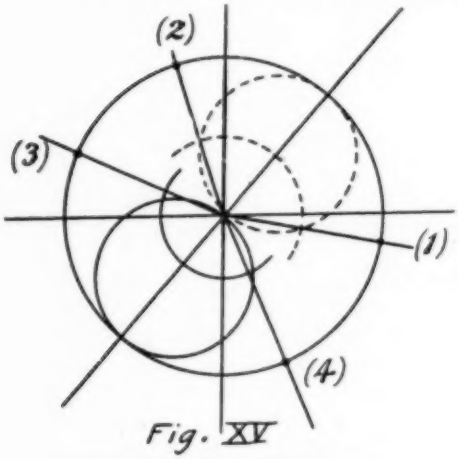


Fig. XV
Normal Top Zeuner

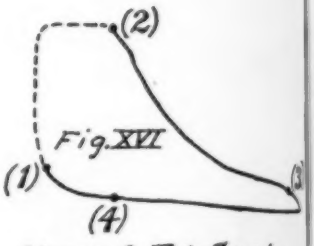


Fig. XVI
Normal Top Card

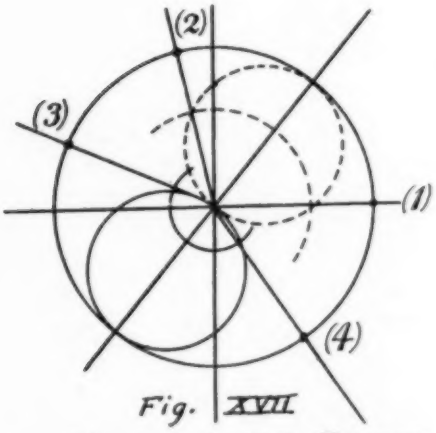


Fig. XVII
Abnormal Top Zeuner

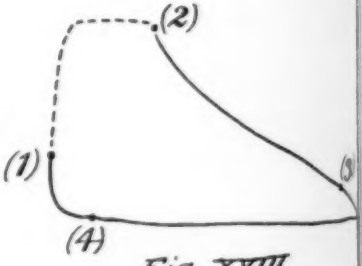
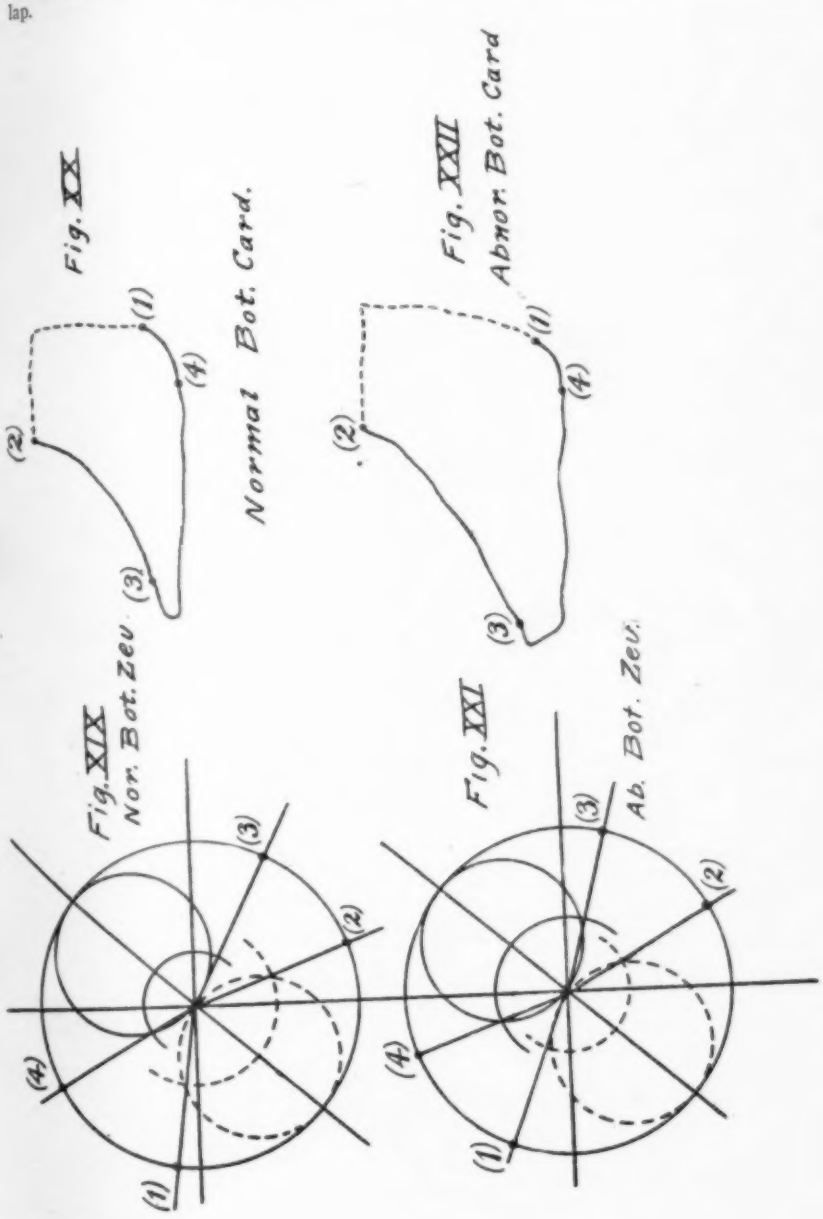


Fig. XVIII
Abnormal Top Card

only be decreased by increasing the steam lap. See Zeuner. It follows also that there will be too little exhaust lap.

The bottom card will show decreased steam lap, and increased exhaust lap.



CASE III.

Excessive Top Steam Lap.

(a) Affects one card only.
(b) Affects two points of one card only.

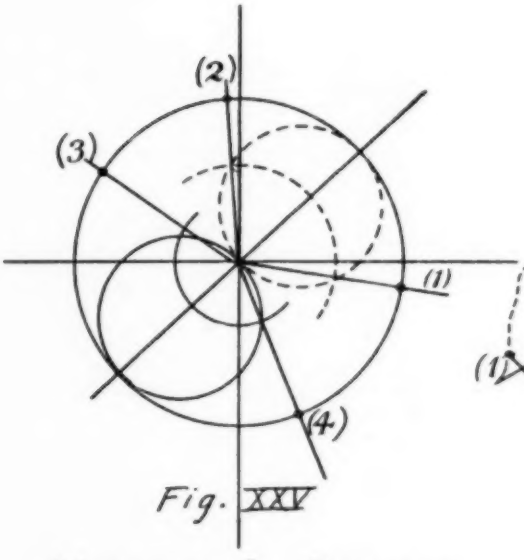


Fig. XXV

Abnormal Zeuner

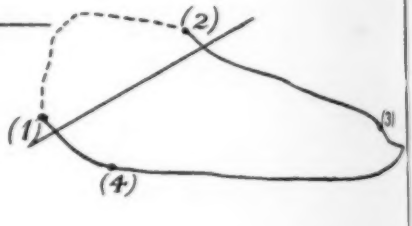


Fig. XXVI

Abnormal Card

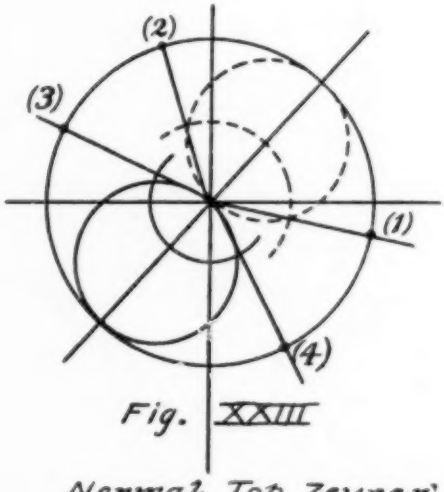


Fig. XXIII

Normal Top Zeuner

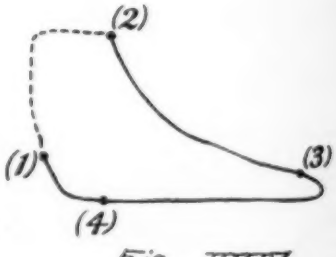


Fig. XXIV

Normal Top Card

BOOK NOTICE

"The Annapolis Plebe," by Lieut.-Commander Edward L. Beach, U. S. N. Published by the Penn Publishing Co., 923 Arch street, Philadelphia, Pa.

Lieutenant-Commander Beach's book, entitled "An Annapolis Plebe," gives to the juvenile readers of this country a faithful narrative of the first year of a boy's life upon entering the Naval National Academy.

The story of Robert Drake's life as a "plebe" will be found both interesting and instructive to those who wish to peep behind the scenes at Annapolis. And to the boy who hearkens to the call of the sea, a call which once sounded can not be easily denied, these realistic pen pictures of the joys and sorrows of an Annapolis Plebe will show the advantage of those superlative qualities, honesty and manliness.

The difficulties ever experienced by the candidate for appointment to the Naval Academy and the honest work necessary to successfully pass the rigid examinations are all graphically portrayed. Next comes his joy upon finding his earnest efforts have not been in vain. Then in the first pride of his neatly fitting midshipman's uniform, he suddenly has thrust upon him the humble position which he has won by unceasing toil—he is but a "plebe" after all and keeps his eyes to the front and answers "sir" to all those who have weathered the storm of the first year at the academy. The boy however is of manly stock and takes his lesson in humility with becoming grace and throughout the long grind of ceaseless toil on the practice cruise, at drill and in the section room his hopes are ever for the day when he will become a "youngster" and be able to lord it over the "plebes" who follow after him.

The routine of life on the practice ship is well told and in a style that should satisfy the appetite of the lad, hungry for the salt taste of the sea. The hardships and worries of the classroom are well glossed over with many and varied exciting incidents, some, if not all, of which are historical, and in consequence the prosaic side of study is thickly veiled.

Hazing, which is said to be a defunct sport, is cleverly described, and even though it has been stricken from the curriculum for the "plebe," a knowledge of what it is and what it stood for will be of great advantage to the reader, bent upon following the life of "those who go down to the sea in ships."

The book will furnish many hours of keen enjoyment, and when the first volume is read, the boy reader will wait impatiently for the succeeding volumes to follow Midshipman Drake through the ups and downs of his life at Annapolis.

YATES STIRLING, JR.

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The Naval Profession. Second Honorable Mention, 1907. By Commander Bradley A. Fiske, U. S. N.

NOTICE.

The U. S. Naval Institute was established in 1873, having for its object the advancement of professional and scientific knowledge in the Navy. It now enters upon its thirty-fourth year of existence, trusting as heretofore for its support to the officers and friends of the Navy. The members of the Board of Control cordially invite the co-operation and aid of their brother officers and others interested in the Navy, in furtherance of the aims of the Institute, by the contribution of papers and communications upon subjects of interest to the naval profession, as well as by personal support and influence.

On the subject of membership the Constitution reads as follows:

ARTICLE VII.

Sec. 1. The Institute shall consist of regular, life, honorary, and associate members.

Sec. 2. Officers of the Navy, Marine Corps, and all civil officers attached to the Naval Service, shall be entitled to become regular or life members, without ballot, on payment of dues or fee to the Secretary and Treasurer. Members who resign from the Navy subsequent to joining the Institute will be regarded as belonging to the class described in this Section.

Sec. 3. The Prize Essayist of each year shall be a life member without payment of fee.

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Sec. 5. Associate members shall be elected from Officers of the Army, Revenue Cutter Service, foreign officers of the Naval and Military professions, and from persons in civil life who may be interested in the purposes of the Institute.

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A prize of two hundred dollars, with a gold medal, and a life-membership in the Institute, is offered by the Naval Institute for the best essay presented on any subject pertaining to the naval profession, subject to the following rules:

1. The award for the prize shall be made by the Board of Control, voting by ballot and without knowledge of the names of the competitors.

2. Each competitor to send his essay in a sealed envelope to the Secretary and Treasurer on or before January 1, 1908. The name of the writer shall not be given in this envelope, but instead thereof a motto. Accompanying the essay a separate sealed envelope will be sent to the Secretary and Treasurer, with the motto on the outside and writer's name and motto inside. This envelope is not to be opened until after the decision of the Board.

3. The successful essay to be published in the Proceedings of the Institute; and the essays of other competitors, receiving honorable mention, to be published also, at the discretion of the Board of Control; and no change shall be made in the text of any competitive essay, published in the Proceedings of the Institute, after it leaves the hands of the Board.

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7. The essay is limited to fifty (50) printed pages of the Proceedings of the Institute.

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9. In the event of the prize being awarded to the winner of a previous year, a gold clasp, suitably engraved, will be given in lieu of the gold medal.

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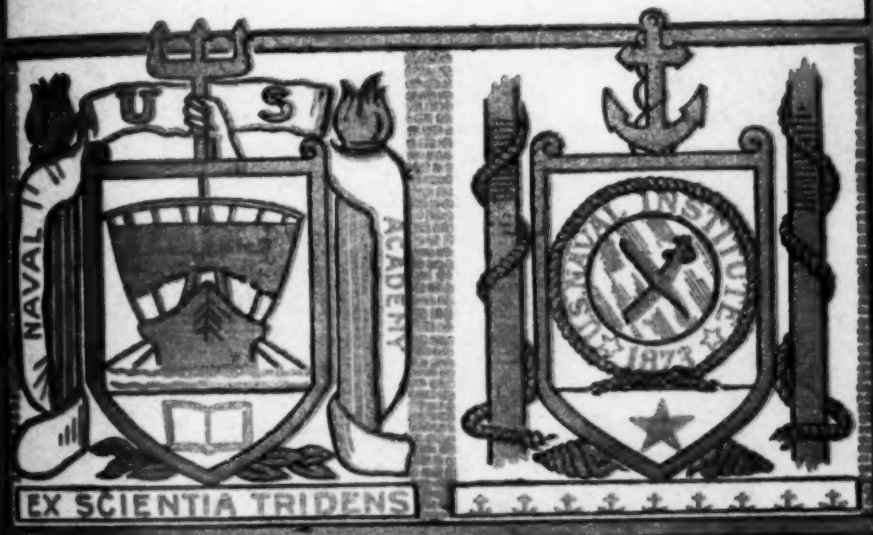

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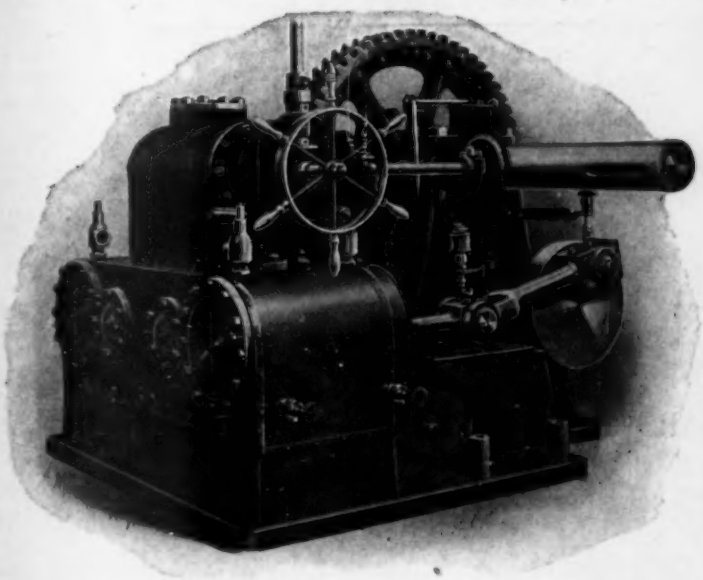

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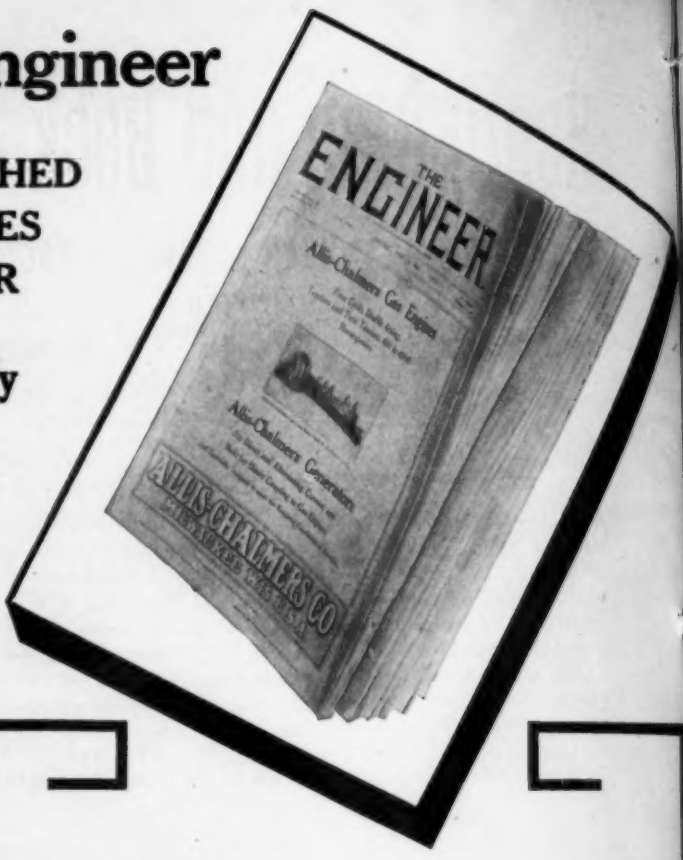

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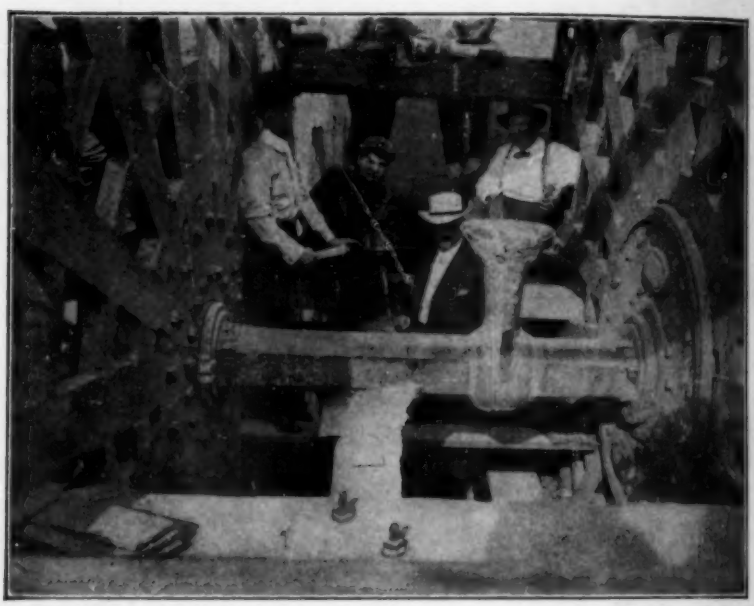

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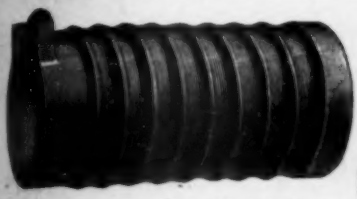

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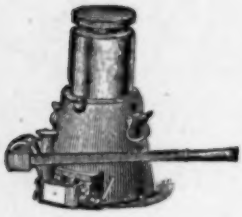

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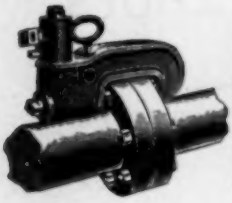

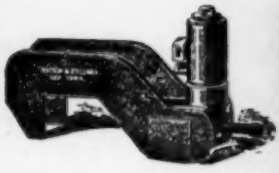

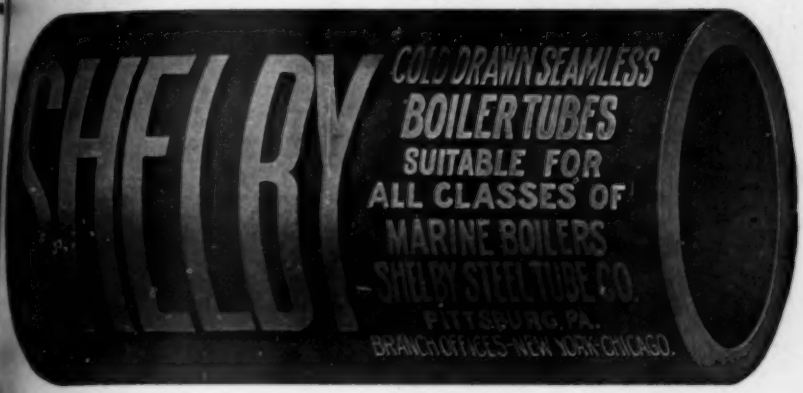

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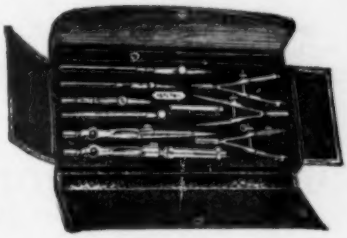

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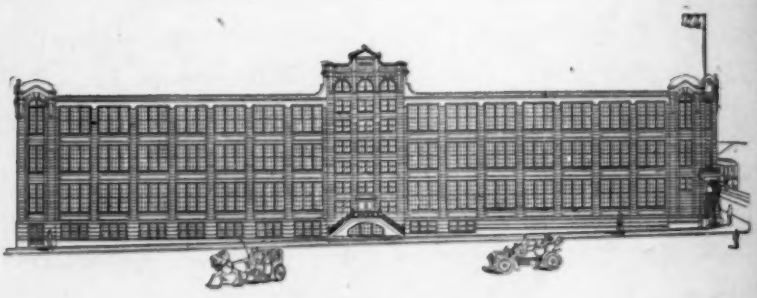

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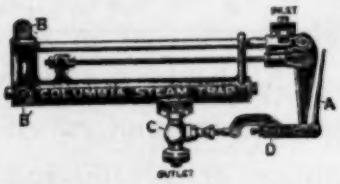

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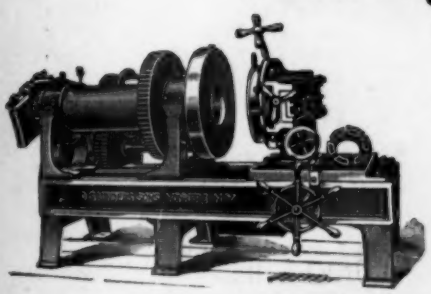

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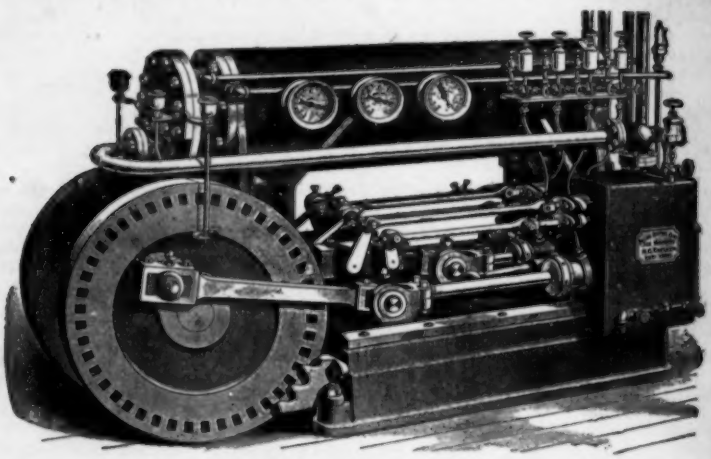

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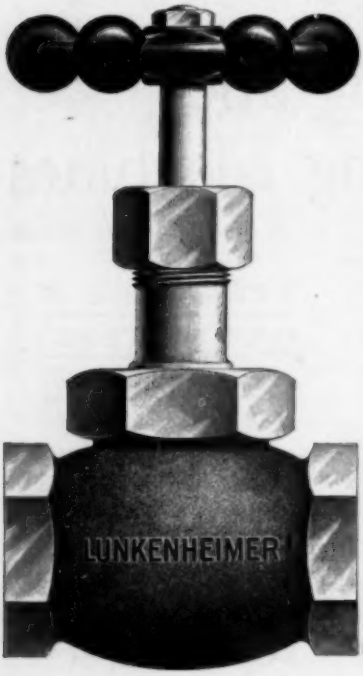

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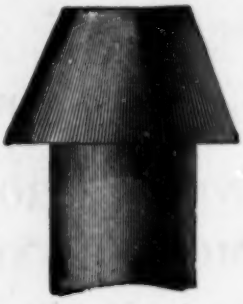

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